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The Socio-Economic Impacts of the Porong Mud Volcano on the Shrimp Fisheries Sector in Sidoarjo District, East Java Province, Indonesia

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This Thesis is presented for the Degree of

Doctor of Philosophy

of

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DEDICATION

I dedicate this thesis to my community, my father, my mother, my wife and Attila my son

DECLARATION

To the best of my knowledge and belief, this thesis contains no material previously published by any other person except where due acknowledgment has been made.

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university.

Signature : Achmad Room Fitrianto

Date : November, 2019

ABSTRACT

The Indonesian shrimp industry has positive and negative social, economic and environmental impacts on local communities. Shrimp has been viewed as pink gold, promising better wealth than other commodities. However, in the case of the Sidoarjo shrimp industry, the massive death of shrimp in the mid-1990s due to inappropriate industrial farming methods, and then the mud volcano eruption in Porong in May 2006, created pressures for farmers to adapt in a variety of ways to high stock losses and attendant environmental changes.

This thesis investigates the socioeconomic impacts of the Porong mud volcano on the shrimp sector in Sidoarjo District, East Java Province, Indonesia, and the responses of shrimp farmers to this disaster. It examines shrimp farmers, government agents, and other stakeholder responses to the mud volcano with a focus on the effects of contamination and disruption of the shrimp sector across five subdistricts divided into two categories based on their proximity to the polluted rivers. Making use of the sustainable livelihoods framework (SLF), the thesis explores: the socioeconomic impacts of such disruptions in shrimp fisheries production; the diverse ways in which shrimp farmers have responded to the changing conditions; and the role of government in supporting shrimp farmer initiatives to mitigate the effects of the pollution.

Qualitative and quantitative research methods were used for data collection. Three questionnaires collected data about the access of sample groups to the five livelihood assets capital, and 17 semi-structured in-depth interviews were conducted using a snowball sampling technique. Finally, the thesis used participant observation of shrimp farmers' responses to the pollution caused by the mud volcano.

This research uses empirical data to demonstrate the socioeconomic impact of river pollution on shrimp fisheries' production. It demonstrates that shrimp farmers livelihoods were impacted because they had to change their cultivation methods in order to retain their livelihood strategies. This thesis also documents and analyses the farmers' responses to reduce the effects of the mud volcano. The most important responses were a greater awareness and monitoring among Sidoarjo shrimp farmers

of environmental conditions, and an increased ability to seek solutions when facing environmental threats.

This research contributes to research through its adaptation of the SLF to the task of investigating the impact of a disaster by examining local livelihood potencies in supporting a resilience process. It also identifies the strategies farmers have used to expand their livelihood assets. Finally it records how local shrimp farmers have negotiated risks in response to a major environmental hazard while operating within the context of a local and globalised aquaculture industry

ACKNOWLEDGEMENTS

This is my thesis. It reports the condition of the shrimp industry in Sidoarjo six years after the mud volcano in Porong. Many researchers start their research degree with full support from their family and high expectations of their community. Frankly speaking, my journey started with disappointment due to my business proposal for a start-up business had been disposed and rejected. Not only that, in my first semester my son was diagnosed with cerebral palsy. A part of his left brain was undeveloped. This condition affects my son's mobility, especially his right hand and leg. It took more than twelve months of work looking for several second opinions toward my son's condition. We visited many podiatrists, physiotherapists, and orthopaedics specialists for their advice about my son. Even the Princess Margaret Children's Hospital's expertise was requested.

Now it is around seven years after that diagnosis, and two years after my son had ten tendons surgically lengthened. Finally, I could finish my thesis. In the middle of finishing my thesis, I almost gave up, then I remembered what Master *Oogway* said to Pooh in the *Kungfu Panda* film "Quit don't quit, noodle don't noodle. You are too concerned with what and what will be, it's said yesterday was history, tomorrow is a mystery but today is a gift that why it's called present."

I didn't realize the importance of being a PhD candidate, desperate, wasting time and wasting money. However, after meeting some people and colleagues I realized that finishing my PhD could inspire my community and I could assist my institution by giving them a good image and providing a constructive program. Then I realized that "I must finish what I started".

This doctoral research helped me to know how to work in a supportive team where I can contribute ideas and that the knowledge gained will help me greatly when I am actively involved in my community.

The intellectual research journey and production of this thesis would not have been possible without the persistent inspiration, encouragement, critical comments, expert guidance and editorial inputs of Dr Tod Jones, my head supervisor as well as Prof Bob Pokrant my former head supervisor and Dr Aileen Hoath, my associate

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LIST OF PUBLICATIONS RELATING TO THIS THESIS

Pollution and the Indonesian Shrimp Industry (Case Study Shrimp farmer behaviors in dealing with disaster), Rites of Spring Graduate Student Conference Curtin University, Australia 2012

Shrimp Farmers' Innovation In Coping With The Disaster (A Case Study In Sidoarjo Mud Volcano Disaster Toward Shrimp Farmers' Responses). *Procedia Economics and Finance*, Volume/Issues: 4C pp. 168-176 DOI 10.1016/S2212-5671(12)00332-2

Supply Chain Risk Management in Shrimp Industry Before and During Mud Volcano Disaster: An Initial Concept. *Online Journal of Procedia Social & Behavioral Sciences*. Volume 65 (2012) International Congress on Interdisciplinary Business and Social Sciences 2012 https://doi.org/10.1016/j.sbspro.2012.11.144

The Impact of Environment Degradation on The Sidoarjo Shrimp Industry SUPPLY CHAIN, 6th International Conference on Operations and Supply Chain Management, Bali, 2014. The operations and supply chain management (OSCM) Forum, Department of Industrial Engineering, Sepuluh Nopember Institute of Technology (ITS), Surabaya, Indonesia, 2014

Shrimp Farmer social Entrepreneur in Creating Sustainable Agriculture, 2nd International Conference on Sustainable Innovation (ICoSI 2014) Muhammadiyah University Yogyakarta, 2014

Sustainable Livelihood Approach Addressing Shrimp Farmers Economic Distress: A Methodological Concept, The CUPSA Inaugural conference 2015. Curtin University

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ABBREVIATIONS AND GLOSSARY

ARG	Ali Ridho Group, one of the role model shrimp associations in Sidoarjo
PT ATINA	Japanese, Indonesian trading company
BPK	*Badan Pemeriksa Keuangan* (Supreme Audit Board)
BPLS	*Badan Penanggulangan Lumpur Sidoarjo* (Sidoarjo Mudflow Management Agency)
BPS	*Badan Pusat Statistik* (National Statistic Agency)
CBIB	*Cara Budidaya Ikan yang Baik* (A good aquaculture technique)
Control group	Non mud affected
Desa	Smallest government level (Village)
DFID	Department for International Development Government of United Kingdom
DKP *Kabupaten Sidoarjo*	*Dinas Kelautan dan Perikanan Kabupaten Sidoarjo*- (Sidoarjo Marine and Fisheries Department)
Eco-shrimp	Shrimp farmer association with cooperation and affiliation to PT ATINA
Environmental assets	Any kind of services that derive from natural resource stocks in supporting the shrimp farmer livelihoods. These include: 1) The distance between the worker and the pond location; 2). The quality and quantity of shrimp fry; 3) mangrove resources; 4) river water quality; and 5) the existing mud volcano in Porong (environmental quality).
Financial asset	Any kind of productive and liquid resources with a cash value and availability that Sidoarjo shrimp farmers use to adopt different livelihood strategies, such as the respondent's income and expenditure, the value of the pond premises, the degree in

	accessing credit and other banking system support, government transfers and other money inflow
FKMT	*Forum Komunikasi Masyarakat Tambak*- (Aquaculture Community Communication Forums)
Gotong royong	Public activity for communal assets' maintenance by villagers
Human asset	Representing the skill, knowledge and ability of people who depend on shrimp culture in pursuing various livelihood strategies
IFOAM	International Federation of Organic Agriculture Movement
Kabupaten	District Government
Kecamatan	Sub District Government
KLHS	*Kajian Lingkungan Hidup Strategies* - Strategic Environment Assessment
KPTOS	*Kelompok Petani Tambak Organik Sidoarjo*- (the Sidoarjo Organic Shrimp Farmers Association)
Lapindo	Lapindo Brantas Incorporated, mining company
Meandering pond model	A river water filter model for shrimp culture using mangroves
Mud Volcano	Sidoarjo Mudflow
Oloran	Land that forms due to fluvial processes (sedimentation)
Pandego	Shrimp pond worker
Penaeus Monodon	Tiger shrimp
Peneaus Vannamei	White shrimp
Pengepul	Small, medium shrimp buyer

Physical assets	Any kind of basic infrastructure and any kind of tool and equipment used to support the productivity of the shrimp culture. Emphasizing the physical assets possessed by the Sidoarjo shrimp farmer, the questionnaire identified and gathered data and information about the irrigation infrastructure data, tools and equipment, the transportation facility, security issue, shelter issue, access to energy (electricity and fuel)
RPJMD	*Rancangan Pembangunan Jangka Menengah Daerah* – (the long-term development plan of the local government)
Silvofishery	Aquaculture that maximises the use of mangrove area
Social assets	Any kind of social resources that develop through the use of social networks and connectedness between persons, between persons and communities and between communities in pursuit of the shrimp farmers' livelihood objectives
Sustainable Livelihoods Framework (SLF)	A development concept for eradicating poverty developed by the Department for International Development, Government of the United Kingdom
Target group	Mud affected water source
TPI	*Tempat Pelelangan Ikan*-(Fish Auction Market)
UMKM	*Usaha Mikro, Kecil dan Menengah* (Micro-scale, Small-scale and Middle-scale Businesses)
UPP	*Unit Pengembangan Pelayanan*- (The Services Development Unit)
WALHI	*Wahana Lingkungan Hidup Indonesia* (Indonesian Environmental Foundation)

PROLOGUE

On 29 May 2006, mud unexpectedly began gushing from the ground some 150 meters away from an exploratory gas well in the Brantas Block concession area in the Porong subdistrict of Sidoarjo, Indonesia. The well, Banjarpanji-1, was operated by a joint Australian-Indonesian company Lapindo Brantas Incorporated (BPK, 2007, p. 172; Gelder & Denie, 2007). This area turned into a mud lake by 2011, covering 680 hectares of land (Susetyo, 2011). The extent of and the causes of the mud volcano required ongoing management as it exposed surrounding residential and industrial areas and transport corridors to an elevated level of risk. The effects of the mud volcano reminded me of a folk-tale in which an evil protagonist succumbed to a mud lake. The folk-tale and the characters who overcome their vulnerability provide some insights into the responses of shrimp farmers who were affected by the disaster. Therefore let me begin with this folk-tale I learned as a child.[1]

I am referring to an ancient story about a pretty girl called *Timun Mas* (gold cucumber) and *Buto Ijo* (Big green monster). The folktale begins with the plight of a married couple who were poor and childless. Every day, they prayed to have a child. One night, when they were praying, an evil person named *Buto Ijo* was passing their house. *Buto Ijo* heard them praying. He stopped by, and responded to their prayers:

"Do not worry. I can help you. But with a condition," he said with a pleasant voice. The man of the couple who was a farmer asked *Buto Ijo* curiously; "what is the condition?"

"You will have a child, a girl, but you must hand over the child to me on her seventeenth birthday," *Buto* responded.

The couple were very pleased and agreed to the terms proposed by *Buto Ijo*. Afterward, *Buto Ijo* gave them some cucumber seeds and said: "Plant the seeds and you will have your wish."

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[1] Nurcahyo (2014) used the same folktale to explain that the mud volcano in Porong is not inherited from the past. Nurcahyo was critiquing Satyana (2007) who explained the Porong mud volcano phenomena through the ancient story

Early morning next day, the farmer sowed the cucumber seeds and soon seedlings emerged. Strangely, after the cucumber vines grew, there was only one fruit which was bigger than a normal cucumber. When it was time for harvesting, the farmer plucked the large cucumber and brought it home. When he cut the cucumber there was a beautiful baby girl inside. This couple were very pleased and named her *Timun Mas*. She grew up and turned out to be a pretty young teenager with good manners and great affection for her parents.

Time passed and *Timun Mas* was almost 17 years old. They knew about the agreement to hand over the girl to *Buto Ijo*, but they did not want to lose their beloved daughter. The couple told *Timun Mas* about their agreement with *Buto Ijo*. After informing the daughter about their agreement to hand her over to *Buto Ijo*, the farmer requested their daughter run away.

Before the planned escape, her parents gave *Timun Mas* three pouchs containing cucumber seeds, salt, and shrimp paste. Each pouch was capable of performing a specific magical function. *Timun Mas* was instructed to throw out the contents of each pouch, each time before *Buto Ijo* came to capture her.

When Buto Ijo approached *Timun Mas*, she threw the first pouch containing cucumber seeds that grew and fruited instantly. *Buto Ijo* was always hungry, Instead of chasing *Timun Mas*, when he saw the cucumbers, he stopped and started eating the fresh cucumber. However, as soon as he finished eating the fresh cucumbers *Buto Ijo* resumed his chase. While *Timun Mas* had moved further away from her evil chaser, *Buto Ijo* was capable of running fast and was closing in on her.

When *Buto Ijo* came closer, *Timun Mas* threw the pouch containing salt. It turned into a wide sea between *Buto Ijo* and *Timun Mas*. *Buto Ijo* was a strong swimmer. However, having eaten too many cucumbers, he found it difficult to swim. Nonetheless, with his stamina and power, *Buto Ijo* finally swam across the sea, even though he was exhausted. Not so long after the Buto Ijo crossed the sea, he saw the foot marks of *Timun Mas* and followed her.

When *Buto Ijo* almost caught her for the third time, *Timun Mas* managed to throw the last pouch containing shrimp paste as advised by her parents. The last small pouch created a huge mud lake. The mud lake was very wide and contained hot and hazardous material. When *Buto Ijo* saw the hot mud lake, he was a bit hesitant to cross the lake to capture *Timun Mas*, but with his ability, power, and desire, he walked through the hot and hazardous mud lake. However, being fatigued and tired after his swim across the sea with a full stomach of cucumber, *Buto Ijo* became unconscious and finally drowned in the hot and hazardous mud lake. At the end of the story, beautiful, young *Timun Mas* escaped from the evil chaser and returned home and re-joined her parents.

This story has four aspects relevant to the concerns of this thesis. The first is that lack of empowerment of the farmer couple who had no children can be read as signifying the plight of the helpless shrimp farmers who were affected by a disaster. The second aspect of the story is 'there are no free lunches'. When *Buto Ijo* offered help for the farmer couple to have a child, *Buto Ijo* also had an agenda much like state offers of assistance to shrimp farmers. The third aspect is that *Timun Mas*'s escape is a symbol of resistance to the vulnerabilities of helpless individuals or groups. Similarly, in the case of Porong, the farmers' efforts in reducing the negative effects of the mud volcano are a resistance and resilience process to keeping their livelihood safe.

Finally, the family's support and three bags of supplies (equipment) represent the assets or resources *Timun Mas* could access to escape from a serious situation (being captured by *Buto Ijo*). Likewise for the Sidoarjo shrimp farmers, they have a serious problem due to the mud volcano; they also have the support, skills, and resources to overcome the disasters.

Returning now to the main topic of this thesis, the hot and toxic mud from the volcano caused significant damage to local physical infrastructure, the environment, and social ties. Some experts argue that the disaster was caused by oil drilling, but others argue that the disaster was triggered by the Yogyakarta earthquake that occurred on May 27, 2006 (Budi, 2008; A. Mazzini et al., 2007; Sawolo, Sutriono, Istadi, & Darmoyo, 2009). In general, experts do agree that the disaster was caused by an underground explosion resulting from a highly-pressurised liquid that seeped

through the surface layer of soil around the drilling site (Budi, 2008; Davies, Mathias, Swarbrick, & Tingay, 2011; Davies, Swarbrick, Evans, & Huuse, 2007; Istadi, Pramono, Sumintadireja, & Alam, 2009). This thesis investigates not the causes, but the response of shrimp farmers, and workers to the mud volcano, in particular what skills and resources were they able to draw on that gave them the resilience to respond to the disaster.

CHAPTER 1. INTRODUCTION

This thesis explores Sidoarjo shrimp farmers' vulnerabilities, identifies their assets and describes the farmers' strategies portfolio in maximizing key resources to deal with the eruption of the Sidoarjo mud volcano in order to sustain their livelihoods. This research is on the topic of community responses to environmental hazards, and draws on community development research about the factors that contribute to local communities and industries' behaviour in response to disasters.

This chapter consists of seven sections: the first section briefly describes the mud volcano. The second section addresses the spread and the danger of the mud volcano. The third section briefly describes the historical background of the disaster and its effect on the local community. The fourth section describes the statement of the problem and research question. This can be summarised as recording and analysing the reactions of Sidoarjo shrimp farmers when facing pollution from the mud volcano. The fifth section details the research objectives. The sixth section describes the significances of the research and the seventh section outlines the thesis structure.

1.1. The Porong Mud Volcano

On 29 May 2006, a mud volcano unexpectedly began gushing out from the ground some 150 meters away from an exploratory gas well in the Brantas Block concession area in the Porong subdistrict of Sidoarjo in Indonesia. The well, Banjarpanji-1, was then operated by Lapindo Brantas Incorporated, a joint Australian-Indonesian company (BPK, 2007; Gelder & Denie, 2007). The mud volcano was a disaster that emerged slowly and affected the region over a long period of time rather than being a short-lived phenomenon (Padawangi, 2016). The amount of mud released rapidly increased from 5,000 cubic metres per day to around 130,000 cubic metres a day (Williamson, 2006). By 2007, the mud volcano had created a giant lake of mud that buried approximately 630 hectares of land and nine villages (BPK, 2007; A. Mazzini et al., 2007). Davies et al. (2011) initially predicted that the eruption could continue until 2035. By 2010, the average daily volume of the mud volcano had dropped to

13,000 m^3 (Primanita & Antara, 2011; Satriastanti, 2011) As I write, the volcano is still active and gushing mud.

By 2011, the mud lake covered 680 hectares of land (Susetyo, 2011) and covered surrounding residential, rural and industrial areas, and transport corridors. By 2009, Lapindo had paid twenty percent of the compensation due to affected parties (Minarak Lapindo Jaya, 2008). Meanwhile the rest of this compensation payment was allocated from the Indonesian national budget as a loan to Lapindo (Padawangi, 2016).

Mud microbiology analysis conducted by the ICBB (the Indonesian Centre for Biodiversity and Biotechnology) showed that the mud volcano in Porong contains dangerous bacteria such as *Coliform*, *Salmonella* and *Staphylococcus aureus* (Priyambodo RH (Ed), 2006). As a result, most irrigation systems within the vicinity were polluted (Herawati, 2007), causing both direct and indirect impacts on the fish and shrimp farming sector in Sidoarjo.

The fish and shrimp farming sector provides employment through fry collecting, hatcheries, shrimp farms, trading and processing, and contributes to the country's foreign exchange earnings. The evidence suggests that fish and shrimp production in Sidoarjo District declined between 2007 and 2009 (DKP Kabupaten Sidoarjo, 2011), with the largest decrease in fish production of 26 percent in the Porong subdistrict. Overall Sidoarjo District experienced a reduction of 24.81 percent in fisheries production in 2008. Much of the shrimp produced in the district is exported to global markets, mainly in Europe, North America and Japan (Ellysamah, 2008; FAO, 2010, 2012).

1.2. The Spread and Toxicity Prediction

The initial mitigation policy adopted by the government agencies focused on diverting muddy and toxic waters to the nearest rivers in Porong subdistrict. The mud that flowed into the sea through Porong River has, directly and indirectly, impacted the coastal and marine environment along the Madura Straits. The volume of disposed muddy water is estimated to be between 120,000 m^3 and 130,000 m^3 per day (Williamson, 2006). The mud takes the form of a silt clay material that hovers on

the surface water. Along with the movement of tidal currents, the sludge material concentrated in coastal areas, and impacted on shrimp farming activities (Brahmana, Tontowi, & Achmad, 2007; Gunradi & Suprapto, 2007; Samsundari & Perwira, 2011; Sudinno, 2009), and in particular, the fisheries activities located along the Madura Straits. Further evidence demonstrated by WALHI through water quality testing on the water surrounding the mud volcano concluded that pollutants in the water exceeded environmental quality standards (Nusantara, 2009).[2]

The hazardous hot mud dammed in Porong was not adequately treated and is affecting surrounding marine life and coastal ecosystems, such as fish and shrimp ponds, mangroves and coral reefs (Gunradi & Suprapto, 2007; Indomaritim Institute, 2011; Samsundari & Perwira, 2011; Sudinno, 2009). Immediately after the eruption, it was found to contain high Total Suspended Solids (TSS) that exceeded safe levels (Mawardi, 2006).The disposed water could cause sedimentation of Sidoarjo coastal areas (Brahmana et al., 2007; Gunradi & Suprapto, 2007). Sedimentation can disrupt the aquatic ecosystem in the long term.

Further research conducted by Samsundari and Perwira (2011) shows that the water pond in the relevant area in Sidoarjo has 0.165 and 0.036 ppm of Copper, a figure that exceeds the level of standard limits. Shrimp gill research by Samsundari and Perwira (2011) concluded that the first water sample had exceeded water quality standards and production for consumption purposes except for cadmium (Cd), which is below the maximum limit of tolerance of heavy metals. The content of heavy metals was identified in the third sample area, which had exceeded the water quality standards and production for consumption purposes. There was lead (Pb) and

[2] Nusantara's research shows that the water was containing Phenol and has TSS (Total Suspended Solids), TDS (Total Dissolved Solids), BOD (Biological Oxygen Demand) and COD (Chemical Oxygen Demand). During the field data collection phase of this research, I saw that mud from the volcano had also been diverted to the Aloo River. During the dry season, the giant mud lake does not flow to the south, but to the north towards the Aloo River. My initial doubts were confirmed by the work of an academic who has tested the water in the Aloo River. The aquatic ecosystem along the Aloo River, especially aquaculture areas in the estuary according to Sudinno (2009) provides evidence. The pollution index of Sidoarjo coastal area was 13.3433, which means that the Sidoarjo coastal area has been heavily polluted. Agustiyani (2011) also mentions that the BOD level in the Aloo River was between 11.25 to 15.75 ppm, which means that the Aloo River's BOD was above the allowed standard.

Cadmium (Cd) in a sample of pond water, and mercury in the shrimp gills and shrimp meat samples. The content of heavy metals in samples of shrimp meat and shrimp gills was higher than the content of heavy metals detected in the samples of pond water. In summary, the mud volcano and its contents threatened the aquaculture in Sidoarjo (Dahuri, 2006; Sudinno, 2009).

1.3. Environmental and Human-Induced Hazard and Disasters

Oliver Smith writes that we "construct our own disaster in so far as disaster arises in the environment that we produce" (Oliver–Smith, 2004, p. 20). Oliver-Smith's assertion applies to the oil exploration by Lapindo Brantas. Oliver-Smith also states that it is society that places people at risk and increases their vulnerability. Thus, earthquakes, mud volcanos, and escaping gasses are agents of human disaster, not the cause. People's vulnerability to disasters is best seen as the result of the interaction or intersection of environment and human systems rather than simply physical exposure to a natural/human-induced event or process (Moore, 1983). More specifically, "… disasters are the result of the conjunction of the human population, which has a historically produced pattern of vulnerability, and a destructive force or agent" (Ensor, 2009). Also, what appears to be a natural event caused by environmental processes is often the result of human intervention. A landslide or volcanic eruption, even a tsunami, may be the outcome of the complex interaction between human activity and natural processes. Its local explanation may take the form of bad luck, God's wrath, or simply the impersonal workings of the natural world (Bankoff, 2003; Kasperson & Pijawka, 1985).

The historical evidence indicates that Porong has been subjected to several mud volcano eruptions. For example, McMichael (2009), using the Dutch Colonial files from 1910, notes that Porong area was considered prone to gas eruptions that occurred in the area. In the 1950s American oil exploration enterprises in East Java were also aware of the area's unstable geological nature. In addition, mining in Indonesia has been subject to legislation such the decree of *Badan Standar Nasional Indonesia* No.13-6910-2002[3] and Presidential decree (*Inpres*) No. 1/1976.[4] The

[3] This decree regulates the off-shore and on-shore drilling procedures.

intent of such regulation is to restrict mining near residential areas and public infrastructure facilities. However, the exploration permits in Brantas Block especially in the Banjarpanji1-well were granted to Lapindo Brantas Incorporated, even though the Banjarpanji1-well exploration site was 5 metres from housing areas, and only 37 metres from the Porong Highway and less than 100 metres from a major gas pipe that runs parallel to the Porong Highway (BPK, 2007). It is evident that the history of geological instability (McMichael, 2009) and the failure to follow regulations were contributory factors for the creation of disaster conditions in Porong.

Economically, the existence of the mud volcano has disrupted the social and economic life of the local community and East Java. This disaster has caused a huge crop failure affecting 800 hectares of paddy fields and has destroyed the main infrastructures in East Java. It has contributed to reducing the number of vehicles that pass through the Porong Highway by between 200,000 and 300,000 daily. In addition, it has also contributed to a loss of domestic income of Rp 170 trillion (A$170 million) in the region during 2007-2008 alone (Yahya, 2008).

The effects of the mud volcano not only impacted shrimp farming activities but also impacted the regional and national economy. In examining such impacts it is important to note that patterns of vulnerability vary according to socioeconomic and political status, gender, ethnic background and other social factors (Quarantelli, 1997). Individual and community adaptation to disasters take many forms depending on the nature of the event and the range of social groups affected by it (Quarantelli, Lawrence, Tierney, & Johnson, 1979).

A disaster lays bare to some degree the underlying social, political and economic mechanisms that regulate community activities that Oliver–Smith (1996) refers to as a natural laboratory. Disaster creates moments of liminality in which taken-for-granted social and other relations become more transparent and potentially open to challenge (Cuny, 1983; Quarantelli, 1997). Understanding the impacts and responses requires attention to patterns of vulnerability and behavioural responses of

[4] This decree integrates the agrarian sector with the forestry, mining, transmigration and general work that is stated in the law number. 11/1967.

individuals, groups and organizations after the disaster and the social changes brought by the effects of the mud volcano in Porong.

Furthermore, it requires attention to how both individuals and communities have responded and sought to reconstruct the infrastructure and their lives in the post-disaster environment. Groups may cooperate or conflict over what constitutes the key priorities for the community, and for economic and social reconstruction. In this sense, disasters are best seen as processes of change, which play out over time with effects that can persist for years and decades (Quarantelli, 2005). They can result in both positive and negative change in pre-disaster social arrangements and cause alterations in the configuration of political forces and institutional arrangements (Petch, 2008).

1.4. Statement of the Problem

Many researchers have investigated the causes and impacts of the mud volcano in Porong (Davies et al., 2007; Fukushima, Mori, Hashimoto, & Kano, 2009; Herawati, 2007; Hoath, 2009; Istadi et al., 2009; Manga, 2007; A Mazzini et al., 2009; McMichael, 2009; Minarak Lapindo Jaya, 2008; Padawangi, 2016; Petch, 2008; Pohl, 2007; Sudinno, 2009; Sulistyarso, 2010; Yahya, 2008). Technical analysis of the mud volcano, its socioeconomic effects, and the pollution of the locality has been a central focus of those researchers. However, the indirect effect upon particular social groups such as in the shrimp farming industry has not yet been investigated. Further, this thesis also contributes to and advances local level disaster mitigation theories regarding sectoral responses to disasters.

The specific problems addressed by this thesis can be summarised as follows. First, how the fisheries sector in Sidoarjo, directly and indirectly, was affected by the mud volcano. This includes the infrastructure damage and the environmental degradation caused by the mud volcano. Second, the reasons for the behavioral responses of shrimp farmers following the disaster in Porong, focusing on how the farmers responded to the loss of shrimp production and the wider impact of the socioeconomic situation in the district. This requires attention to events over the last

twenty years that increased shrimp farmers resilience, and so are relevant to how they have responded to the mud volcano.

1.5. Research Objective

The research examines the impacts of the Porong mud volcano on the shrimp industry located within its vicinity. It has two objectives:

1. to review the effects of the Porong mud volcano on shrimp farmers and the shrimp production sector; and
2. to examine how shrimp farmers have responded to and dealt with the effects of the mud volcano, with a particular emphasis on the extent to which farmers were able to develop shrimp culture techniques and other adaptive strategies to deal with effects of the mud volcano.

1.6. Significance of the Research

The research significantly contributes to understanding shrimp farmer livelihood strategies in Porong in the first six years after the disaster. It takes a longitudinal approach to demonstrate how the mud volcano affected the resilience of shrimp farmers and therefore their response to the eruption. The thesis argues that shrimp farmers' prior learnings from earlier disasters (in this case, state-led industrial shrimp farming) need to be considered when undertaking research on community responses to later disasters.

This thesis also identifies the roles and influence of the range of actors and agents involved in managing a significant disaster in Indonesia. This documentation contributes to the advancement of disaster mitigation literature emerging from the Indonesian case study.

In summary, the significance of this research is:

1. the development of improved approaches to disaster mitigation management by identifying the importance of human responses of local communities;
2. advancement of knowledge to understand how different formal and informal actors in Indonesia respond to a disaster and the processes adopted to mitigate

effects, with a special focus on innovative and creative approaches utilised by shrimp farmers in a particular community;

3. contribution to the development of the capacity of community responses to specific impacts of disasters within the broader socioeconomic context;
4. identifying the lessons learned from a major disaster in Indonesia; and
5. the value of using the Sustainable Livelihood Framework (SLF) to analyse adaptive behaviour in response to a disaster, which adds to the body of disaster literature that makes use of the SLF.

Although the research focuses on a specific problem encountered by shrimp farmers in the Porong district in Indonesia, the findings of the research will have both national and international significance in advancing disaster mitigation theories and methods.

1.7. Thesis Organization

Chapter one is an introduction to the thesis and provides background information, including the statement of the problem, the research objective, and the significance of the research.

Chapter two reviews the literature in order to establish contemporary theoretical approaches relevant to the central concerns of this thesis: (i) The actual extent of the mud volcano contamination and disruption of shrimp fisheries sector across the subdistricts; (ii) the socioeconomic impact of such disruptions affecting shrimp fisheries production; and (iii) identification of the farmers' responses to reduce the effects of the mud volcano into the Porong River and the Brantas River, and the associated shrimp production in this geographical location. This chapter introduces the Sustainable Livelihoods Framework (SLF) and explains why it is an appropriate tool for assessing disasters like the Porong mud volcano.

The third chapter draws on existing literature to describe the Sidoarjo district. As identified in the sustainable livelihoods literature, environmental, economic and political conditions that contribute to economic development can also expose certain sectors and communities to new vulnerabilities.

Chapter four provides the research methodology, including various analytical tools employed in field data collection, in particular my use of the Sustainable Livelihood Framework. Qualitative and quantitative research methods were used for data collection. Three clusters of the questionnaire were developed to collect the data about the access of sample groups to the five livelihood assets capital, and approximately 17 semi-structured in-depth interviews were conducted using a snowball sampling technique. Participant observation was another important method used for data collection.

The three data chapters focusses on two key elements of the Sustainable Livelihoods Framework in order to meet the thesis objectives: the five types of capital (environmental, human, social, physical and financial) that are used to generate livelihood outcomes, and the transforming structures and processes that allow shrimp farmers to utilise their capital in different livelihood strategies. The SLF is described in chapter two, and these terms are defined in more detail in chapter four.

Chapter five investigates the strategies and portfolios used by shrimp farmers in Sidoarjo to preserve and strengthen their environmental capital, often through increasing their human capital (knowledge of shrimp farming practices). This chapter therefore addresses shrimp farmers' capacity to deal with the environmental threats from the mud volcano.

Chapter six describes the social, physical and financial capital of the Sidoarjo shrimp pond and work environment based on survey data that compares the situations and experiences of two groups of shrimp farmers operating in two types of locations based on their proximity to the toxic mud.[5] This chapter also combines data from chapters five and six in order to make a holistic comparison between shrimp farmers who were greatly affected by pollution from the mud volcano with shrimp farmers who were minimally affected. The significance of the different types of capital is important to understanding variations of resilience and vulnerability within the sector.

[5] Chapter six includes some information on human capital due to its close relationship with social capital. This is discussed at the start of chapter six.

Chapter seven addresses how transforming structures and processes influenced the livelihood strategies of Sidoarjo shrimp farmers, including their capacity to adapt in order to maintain their livelihood strategy. This chapter identifies the institutions and processes that were available to them to address the effects of the mud volcano. It addresses changes in the supply chain, the roles of shrimp farmers assocations, and government programs.

The concluding chapter summarises how disasters not only destroy livelihoods but provide opportunities for recovery through necessitating creative and innovative approaches. The thesis concludes by providing a series of recommendations on how government responses could be restructured based on the lessons learned from this particular disaster.

CHAPTER 2. THE LITERATURE REVIEW

This literature review seeks to establish contemporary understandings of three concerns central to this thesis, which investigates the effects of the Porong mud volcano disaster on the local shrimp farmers and the shrimp industry in Sidoarjo. As outlined in chapter one, the first concern is to establish the nature and scope of environmental hazards that emerged from the Porong mud volcano; particularly its impact on shrimp farmers who owned or worked at shrimp ponds in the impacted area. The second concern is to identify the socioeconomic impact of shrimp farmers operating in the affected area. The third research focus is the local shrimp industry actors' creativity and innovation to reduce the effects of the mud volcano into the Porong River and the Brantas River, and the associated shrimp production. Collectively, these three foci, act as windows into understanding how local shrimp farmers have negotiated risks in response to a major environmental hazard while operating within the context of a local and globalised aquaculture industry.

This chapter consists of five sections including this introduction. The first section reviews the literature concerning disasters in general and human induced disasters in particular. This section focuses on the local community members' adaptation processes to adverse conditions arising from a catastrophic environmental event.

The second section considers the relevance of supply chain risk management and the nature of the supply chain processes as tools for understanding the adaptation of broader responses to rapid environmental changes occurring within the shrimp industry sector. Understanding supply chains is essential to understanding resilience in the Sidoarjo shrimp industry due in particular to the requirements for shrimp production of international exporters. The third section introduces the Sustainable Livelihood Framework (SLF) that is adapted to address the issues investigated in the thesis. Further, in this section I argue that adopting an appropriately adapted SLF will connect and cast light on the multi-dimensional issues covered in this thesis. The final section concludes this chapter.

2.1. Disasters and environmental degradation

Historically, disasters have been classified as either environmental catastrophes or the punishment of God (Bankoff, 2003; Hewitt, 1983). Berren, Beigel, and Ghertner (1980) and Guha-Sapir, Vos, Below, and Penserre (2012) categorize disasters as either environmental or technological. Disasters are recognised as events that emerge due to changes in the physical or biological environment[6]. They can include floods, landslides, earthquakes and similar events or disease outbreaks. Technological disasters are events that occur due to the misuse or the failure of technology.[7] An example is the Bhopal disaster in India due to the mismanagement of a battery plant

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[6] In some respect a disaster framed in the context of political ecology. The term 'political ecology', was first used in the 1970s by Eric Wolf (1972) who highlights the power relationships between humans and their environment. Wolf (1972, p. 9) argues that environments and technologies are socially developed and constructed phenomena based on the combination of human satisfactions and conflicting needs and interests. Contemporary trends in political ecology can be traced to Blaikie and Brookfield (1987) who broadly conceive political ecology as a social discourse interacting between ecology and the political economy. Political ecology has also been influenced by those scholars who studied hazards or disasters in the context of the environment a trend that goes back to the late 1970s (Burton, Kates, & White, 1993), with its focus on perception, adjustment, and management of environmental hazards.

Political ecology's capacity to address complexity has been portrayed by Watts and Peet (2004) through two schemes. First, political ecology explores the complex relationships between nature and society through an analysis of the social forms of access and control individuals, or communities exercise over various forms of assets. Second, political ecology recognises the importance of indigenous technical knowledge within a global knowledge network. According to Forsyth (2008, p. 762), political ecology is an epistemology of social justice that addresses, through the relationship of political and environmental knowledge, humans' vulnerability issues. Peet and Watts (2004) and Robbins (2012) also underline political ecology as a discourse that has the potential to enhance our understanding of the political dimensions of mitigation, conservation, and development issues, and their work confirms the use of political ecology as a set of tools for understanding environmental hazards. Political ecology as a field of research has begun shifting its direction and no longer overly focuses on the role of political economy, which is now considered too macro-deterministic (Robbins, 2012). Oliver-Smith (2010) and P. A. Walker (2005) define political ecology as a logical framework that usefully explains different scales of human relationships enabling us to understand the environment as a landscape. Adding to those definitions, Robbins (2012) describes political ecology as a logical framework for conducting research that requires multiple time-series information and perspectives.

[7] Technology in this term is the human activities that induced a natural hazard. The environment changing mud flow in Porong is the evidence of human involvement that triggered an environment hazard.

operated by an American company (Broughton, 2005; Carlsten, 2003; Castleman B, 1985; Dhara, 2002; Irani & Mahashur, 1986). A disaster may be comprised of a single event (De Boer, 1990; Perry, 2007) or the cumulative effects of multiple events (Oliver-Smith, 2010). More recently, disasters have also been recognised as complex events because they occur at the intersection between environmental phenomena and human activities. Oliver-Smith (2010) defines a disaster as a process of disturbances of relations among nature, technological applications, and human behaviours. Such interconnectivity and complexity are evident in the case of the Porong mud volcano when viewed beside the existing Sidoarjos' industrial pollution from 1975-2006 (Ridho'i, 2017)

The consequences of a disaster manifest in different ways. De Boer (1990) defines a disaster as a destructive event that disrupts people by preventing them from accessing resources. For Perry (2007), a disaster is an event that destroys the social structure. The Centre for Research on the Epidemiology of Disasters (CRED) identifies the scale of an impact as a defining feature of a disaster:

> *A situation or event which overwhelms local capacity, necessitating a request to a national or international level for external assistance; an unforeseen and often sudden event that causes great damage, destruction and human suffering* (Guha-Sapir et al., 2012).

Taking an economic perspective, Bellemare (2015) defines any kind of event that causes fluctuating and rising food prices and contributes to food insecurity as a disaster. In the long term, the unpredictable and uncontrollable prices of goods and services create social tensions.

Furthermore, Klein (2007) points out two components of disasters. On one hand, disasters cause massive destruction, and on the other, can also create opportunities to redistribute wealth. Similarly, Oliver–Smith (2009) asserts that disasters can create situations where power relations and arrangements, especially those that increase the risk vulnerability of particular groups, are perceived more clearly by affected people. Important work has drawn attention to gendered vulnerabilities and the need for consideration of special groups such as those persons with disabilities (Fjord & Manderson, 2009; Sultana, 2010).

Albala-Bertrand (1993) and Bolin, Jackson, and Crist (1998) define vulnerability as a measurement of the extent of the resistance of a society in dealing with or recovering from exceptional events. Oliver–Smith (2004, p. 10) defines vulnerability as a conceptual nexus that explains the peoples' relationship with their environment, to social forces and institutions, and the cultural values that sustain or challenge them. Addressing all those definitions above, Kahn (2005) listed three factors that influence humans' vulnerability: access to income, the geographical location, and the responses from institutions.[8]

In addition, J. Lewis and Kelman (2012) identify seven variables,[9] typically initiated by the actions and activities of others that drive humans' vulnerability: (i) environmental degradation; (ii) discrimination; (iii) displacement; (iv) self-seeking public expenditure; (v) denial of access to resources; (vi) corruption; and (vii) tapping of public money. These variables influence the communities' adaptation to environmental changes following disasters. The authors further categorise these variables into two clusters. The first cluster is the endangerment cluster. This cluster consists of environmental degradation, discrimination, and displacements. The second cluster is impoverishment. This cluster consists of: self-seeking public expenditure; denial of access to resources; corruption; and tapping of public money. (J. Lewis & Kelman, 2012). In the long term, if impoverishment increases, it also creates further vulnerability in the affected community. These variables demonstrate the complexity that can hinder affected individuals or communities in getting an adequate livelihood after a disaster.

The concept of vulnerability highlights two factors within the multidimensional nature of a disaster. First, it assists us to pay attention to the social relationships of the affected community and members of specific groups. Second, it portrays the

[8] Civil society representation or the government agency functions at the local and sub-divisional level

[9] These seven variables are also acknowledged as factors that caused marginality (Gurung & Kollmair, 2005; Leimgruber, 2004; Noguera, 2003, p. 445; Peet & Watts, 2004, p. 9; Robbins, 2012, p. 91; Webster, MacDonald, & Simpson, 2006)

power and the interaction of the social groups and the environment that influence the recovery and reconstruction activities (Oliver–Smith, 2004).

This literature review demonstrates that the concept of vulnerability is closely linked to the fundamental issues of causation and disaster management. Further, the concept of vulnerability is one means to develop a holistic understanding of problems faced by an affected community following a disaster. The Porong mud volcano is a multi-dimensional disaster, and the damage it has caused is similarly multidimensional, impacting people's livelihoods in multiple ways.

According to Quarantelli (1997), people react differently in response to disasters to reduce their pain and losses. Prolonged situations force people to seek solutions or help for minimising the risk (O. Tang & Musa, 2011). When local people cannot understand the variables that trigger a disaster, it compounds their helpless situation. Community awareness of an environmental hazard depends on the skills and knowledge of the community members (Quarantelli, 1997). The awareness of the local people is of vital importance for the preparedness of the community when facing disasters. Community awareness helps reduce potential losses (Quarantelli, 1997). Asghar, Alahakoon, and Churilov (2008) summarise that community capacity to cope with disaster complexity depends on the knowledge of the local people toward several parameters: the degree of interaction among the community members; and the level of technological mastery.

Therefore, failure to identify and recognise the factors that triggered a disaster, and a lack of resources and capacity to respond increase the fatalities and other negative consequences. According to Tivendale (2008), poor mitigation strategies can further compound negative outcomes emerging from a disaster event. Quarantelli (1997) and Asghar et al. (2008) emphasise that human involvement in disasters depends on the degree of understanding of the event, its extent and the damage caused by the event. For example, the 2011 tsunami disaster in Japan caused damages to nuclear reactors and the leaking of radioactive substances into the environment. The effects of the earthquake and tsunami were compounded by inadequate technology, which in this case, caused a breakdown of a nuclear power plant in Fukushima (Merz, Shozugawa, & Steinhauser, 2015).

Quarantelli (1997) argues that institutional responses play an important role in reducing the impacts of disasters on local communities. Institutional responses to disasters are influenced by religion and rituals, technology, economy, politics and the policy-making patterns (Oliver–Smith, 1999). Therefore, to investigate how a particular community of interest responds to conditions and effects from a disaster, the researcher must pay attention not only to individuals who comprise the community, but also to the responses of government agencies and other organisations. Such an investigation needs to include an examination of the interactions between the different interest groups responsible for managing the aftermath of the disaster (Cuny, 1983; Quarantelli, 1997). According to Bornstein (2007), the local community's response to a disaster depends on several factors. These factors include: the degree of resulting damage; the degree of disturbances caused and the ability of the community to recover and reconstruct their livelihood. Therefore, peoples' interaction with each other and the overall response of a given local community to a disaster will vary.

In addition to the quality of institutional responses, the existing infrastructure also determines the degree of readiness of the affected community to respond. De Boer (1990) argues that inadequate infrastructure frustrates mitigation programs and creates further impacts due to the delay of receiving help due to limited access to transportation. Further, Berren et al. (1980), Chambers (2005), and J. Lewis and Kelman (2012) point out that environmental degradation, social conflict, famine, displacement, population density, industrial accidents and transport accidents are a few causes that compound negative effects of a disaster. These effects are investigated and discussed in relation to the Porong mud volcano in chapters 3, 5 and 6.

Nusantara (2009),Drake (2016), Ridho'i (2017) and Novenanto (2017) address the situation in Porong as part of community and government dynamics. Nusantara (2009) demonstrates that the businesses covered their mismanagement in drilling activities and utilized the media in order to divert the issues to be seen as just a disaster. In more detail, (Drake, 2016) and (Novenanto, 2017) analyse power relationships among business, community and government in Porong relating to the

mud volcano. Ridho'i (2017) provides important context through his analysis of industrial pollution in Sidoarjo from 1975-2006.

In summary, the literature reviewed demonstrates that the extent of damage from a disastrous event relates to the vulnerability of those affected, which in turn is connected to their community cohesion, readiness, resources and institutional responses. The next stage is to define the tools that can measure the local community and local sectoral interests' responses and adaptive strategies to disaster events and how they impact livelihood capabilities. According to Chambers and Conway (1992), DFID (1999), Clark and Carney (2008), Ludi and Slater (2008), Morse (2013), and Scoones (2000, 2016), the SLF allows a holistic approach initially devised to assist in understanding the multiple causes of poverty and to find sustainable livelihood solutions for those most in need. The SLF framework provides a basis for understanding the changing circumstances of shrimp farmers, managers and workers, whose livelihood capacities and practices were vulnerable to the impacts of the Porong mud volcano.

2.2. Sustainable Livelihood Framework (SLF)

The previous sections have outlined the relevant literature on disaster studies. This section discusses the Sustainable Livelihood Framework (SLF) as a research tool to investigate and identify the impacts of the Porong mud volcano disaster for the local shrimp industry and particular shrimp farmers. Furthermore, the SLF also draws attention to the factors impinging on livelihoods.

The term livelihoods has been defined in several ways, those considered in respect to this thesis are: livelihood is considered as abilities in managing assets or resources, entitlement to make a living (Chambers & Conway, 1992, p. 6). Slightly differently Scoones (2009, p. 172) describes livelihood as the dynamic process of development and practices that relate to locales, occupation, social difference, and social trajectories of a society in creating better live. Bridging those two definitions, Ta (2010) defines livelihood as opportunities and the multiple activities used to earn a living. I define livelihood as any aspect of the assets and resources that contribute to people making a living. This research focuses upon Sidoarjo shrimp farmers'

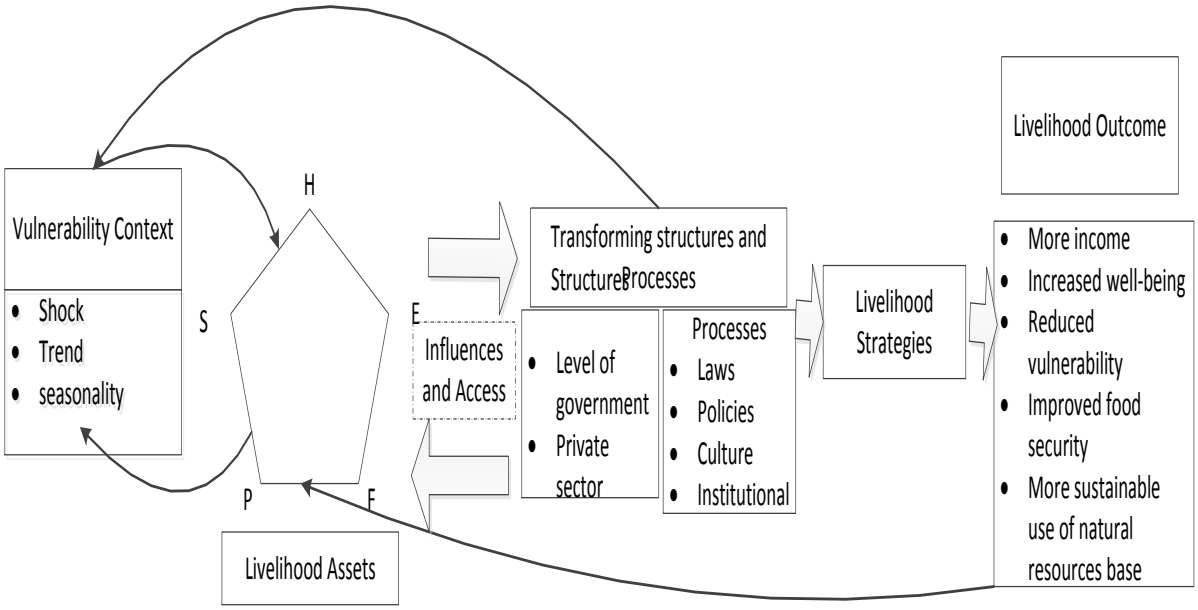
capabilities to cope with perturbations and being able to find and make use of their potentials and challenges by encompassing all approaches which may increase their shrimps fisheries' production.

The SLF was promoted by a number of development agencies as a holistic approach to understanding the multiple causes of poverty and developing sustainable livelihood solutions for those most in need (Chambers & Conway, 1992; DFID, 1999; Ludi & Slater, 2008; Scoones, 1998). More recent studies indicate the SLF continues to be used to analyse issues relating to household-level or community-related issues (Morse, 2013). Subsequently, the SLF has also been adapted, modified, or expanded and applied to different circumstances in developing and developed nations as discussed by Ludi and Slater (2008) and Collins (2009).

A small body of work studying aquaculture livelihoods exists. Topics include understanding the capability of Indonesian shrimp producers to participate in lucrative export market (I. Sari, 2015), outsiders and access to fishing grounds in the Berau marine protected area (Gunawan & Visser, 2012), counting livelihoods' resilience of fishing communities in Cambodia (Marcshke & Berkes, 2005; Marschke & Berkes, 2006), livelihoods' assets through community based management in Bangladesh (Islam, Abdullah, Viswanathan, & Yew, 2006), household fisheries in Lao PDR (Garaway, 2005), and, fisheries and female agency in a Madurese fishing village in Indonesia (Niehof, 2007). Moreover, Allison and Ellis (2001); Allison and Horemans (2006) developed conceptual studies of sustainable livelihoods of small-scale fisheries and fisheries development.

As represented in Chart 2.1, the SLF serves as a framework enabling the collection and categorisation of information from various sources. It identifies key elements including the social, physical, human, environmental and financial assets of a given local community or interest group in an integrated manner. It also reflects that inherent risks such as disasters and environmental hazards that act as barriers preventing or obstructing local communities to key capital access assets use five capital assets of the SLF. The SLF also pays attention to identifying resources that support the structural and social transformation in developing or facilitating sustainable livelihood strategies.

Chart 2.1The sustainable livelihood framework



Source: DFID (1999) (modified)

Note: S= social; P=physical; H= human; E=environmental; F= financial

Information collected using the SLF could also assist and provide input into policy-making processes. Developing food security strategies or poverty alleviation strategies are two examples of the use of livelihood strategies (Krantz, 2001; Ludi & Slater, 2008; Rakodi & Lloyd-Jones, 2002; Skees, 2000).

According to Cumming and Collier (2005), and Cumming et al. (2005) four aspects assist understanding of livelihood responses: first, mapping and collecting the information about the livelihood assets (human and non-human actors of the system), second, identifying the relationships and the interaction of the livelihood assets components, third, understanding the motivation and stimulant of innovation that generate change and novelty, and fourth, ability to manage the sources of continuity and togetherness among society members that help maintain sustainability through space and time.

Chambers and Conway (1992) and Scoones (2015a) highlight that the SLF can be used to identify economic and social backgrounds of people in a given scenario or situation. Understanding the vulnerable conditions affecting local communities requires a holistic approach and tools to gather information about a given community. One such tool is utilising a baseline survey to gather information about the existing conditions of a local community. The information gathered from a baseline survey for a SLF based method consists of a set of data elements that answer fundamental questions on how communities interact in solving the problems they face from year to year.

Scoones (2009) highlights that investigations into livelihoods have been developed through multidisciplinary studies, including rural area studies, agricultural systems analyses, and political ecological studies. As such they have expanded the scope of rural development thinking.

> *A complex archaeology of ideas and practices is revealed which demonstrates the hybrid nature of such concepts, bridging perspectives across different fields of rural development scholarship and practice...(Scoones, 2009, p. 171).*

Carr (2014) also supports the need for integrating sectoral boundaries where various disciplines combine different data and perspectives. How people live and make their incomes, how they struggle and take action for adaptation, how people respond to a given situation, and how they make adjustments toward what is happening in their environment, are all related to people's behaviour.

Krantz (2001, pp. 8-10) identifies three strengths of the SLF in portraying community behaviour. The first is the SLF's ability to identify opportunities available for communities to increase their economic prospects. This is because the SLF is capable of identifying human behaviour issues even at the household levels. Further, the SLF is also useful to analyse the daily lives of community members, especially the livelihood patterns of the poor. Therefore, the SLF has an inherent capacity to identify alternative livelihood strategies for solving a specific problem of a given community.

According to Krantz (2001), the second strength of the SLF is its ability to conduct holistic analysis not only on economics and financial issues, but also on other dimensions such as the health services, the democratisation of policy-making, literacy levels that prevail in a community, and the ability to address many other social issues such as poverty levels and income sources.

Third, the SLF analysis is a people-centric methodology, meaning that its analysis starts from the premise that the community understands their own vulnerabilities and also their strengths. Therefore, the collection of information on the dynamics of community participation and involvement data is of vital importance. Disaster studies also involve the observation of the behaviours of community members as research objects and could be used as a tool in generating social transformation and strengthening institutional power arrangements by supporting the essential components of the SLF.

However, the SLF could create broader structural constraints where local residents have limited controls and influences toward the issues encountered (Kelman & Mather, 2008; Scoones, 2009, 2015a). Scoones (2009, p. 183) explains that "knowledge, politics, scale, and dynamics" is the early lens of the SLF analysis. He argues that a tendency to retract from the challenges and potential insights to be gained from contextual, trans-disciplinary and cross-sectoral approaches default back to the predictable outputs of microeconomic analysis. This limits the development of a discourse between institutions, social movements, government and policy practitioners (Scoones, 2009, pp. 185-187). As result, an output of the SLF could be deficient due to the lack of attention to power and politics and a disjuncture in an analysis of macro and micro contexts and also of agency and its structures (Scoones, 2009, p. 186; Serrat, 2008).

The second critique against the SLF is related to the second component of SLF; the 'transformation process' and 'the power relations' among the stakeholders in the local community that shape but can also blur community dynamism. Krantz (2001) and Scoones (2009) note informal structures of social dominance and power within the communities themselves often influenced livelihood output.

SLF approaches can also underemphasise broader factors causing vulnerability such as macroeconomic trends. This is because the SLF tends to focus on the local perspective especially when its components are formulated for understanding poverty and identifying effective poverty reduction strategies (Serrat, 2008). As a result, the productivity of the community and wider marketing issues are not clearly represented in the SLF. However, the SLF has innate features such as identifying livelihood strategies and mapping of vulnerability factors. There are two aspects identified in mapping a community's vulnerability. The first aspect is analysis of social changes in local communities, and the second aspect is the factors that influence community resilience (Oliver–Smith, 1996, pp. 314-315). Mapping of vulnerability factors utilising the SLF is similar to and compatible with the methods employed in hazard and disaster research providing another justification for adapting it as a research tool for this thesis.

The mud volcano disaster in Porong has created risks, increased vulnerability among shrimp farmers, and also disrupted the supply chain. Appropriate risk management strategies facilitate forecasting future losses or benefit to be gained as a result of a disaster impacting the supply chain process (Moore, 1983; Omera & Bernard, 2007). One such key issue identified in this literature review is the impact and the influence of supply chain risk management, which is the focus of the following section.

2.3. Supply chain risk management and resilience

As discussed in Section 2.2, the sustainable livelihood framework identifies shrimp farmers' vulnerability as an important factor in understanding the impact of the mud volcano. Furthermore, section 2.2 also notes the importance of the transformations in livelihood assets that occurred before and after the disaster. The behaviour of stakeholders involved in the shrimp industry are an important component that shapes the resilience of shrimp farmers, and is therefore central to this research. Transformations in the supply chain of the shrimp industry in Sidoarjo have driven important shifts in stakeholder behaviour and assets. In this regard, it is important to review the definition of supply chain, risk management, and resilience.

The main rationale is that issues connected with the supply chain have also contributed to vulnerability and resilience due to their relationship with shrimp farming practices in Sidoarjo. Supply chain risk management has four aspects. These are: (i) identifying the sources of risks and consequences; (ii) overcoming any possible consequences; (iii) outlining the drivers of risks; and (iv) adopting risk mitigation methods (Jüttner, Peck, & Christopher, 2003; O. Tang, Matsukawa, & Nakashima, 2012). These four aspects of supply chain risk management assist the decision-makers to make the right decisions to protect the business from potential consequences including losses. Supporting four aspects of supply chain risk management, Ritchie and Brindley (2007) outline four strategic steps in measuring risk performance: (i) analysing the performance risks, (ii) their consequences, (iii) responding to risks, and (iv) evaluating final outcomes.

I now turn to issues relating to supply chain risk management concepts in the context of this research. A systematic consideration of the supply chain and its nodes, especially in the context of the shrimp farming sector is important when understanding a supply chain as a whole (Collins, 2001; Stadtler, 2015). A supply chain is a complex interrelated network of activities of many contributors to obtain materials, transform the material into products, and finally distribute the products to consumers (Muckstadt, Murray, Rappold, & Collins, 2001; Stadtler, 2015; Tan, 2001). A supply chain includes any kind of processes and activities that relate to the flow of a product from suppliers to end-users and vice versa (Mensah & Merkuryev, 2014).

The shrimp culture as a business has a supply chain system. The supply chain system of shrimp culture is categorised as an agribusiness. According to Drilon Jr (1971, p. 21), agribusiness has four dimensions. First, agribusiness is multi-faceted. Second, it has decision-making complexities. The third dimension is that the long-term viability of the industry is derived from the viability of the firms that form the industry and the fourth dimension is that it has a market orientation.

There are three patterns of relationships in the supply chain cycle associated with the shrimp industry, especially in the production process of shrimp culture, namely; (a) patron-client relationships, (b) principal-agent relationships (Keefer, 2007; Nichter &

Peress, 2016; Noor, 2006; D. Sari, Alam, & Beaumont, 2008) and (c) business foster-parent relationships (D. Sari et al., 2008). The patron-client relationship is essentially a mutual arrangement between an individual who has expertise, social status, wealth, or some other personal resource being the patron, and another person, the client who benefits from the support or influence from that patron (Eisenstadt & Roniger, 1980; Hall, 1974; J. C. Scott, 1972), and is considered an important component of Indonesia's political system and political economy(Crouch, 1978). It is a reciprocal relationship between two groups of people or between two individuals constructed on the basis of mutual benefit, via mutual giving and receiving (Legg, 1976; J. Scott, 1972). Simkins (2011) explains that in this bond, the patron party has an obligation to pay attention to their client as a father does to his son.

In the case of shrimp farming, shrimp farmers[10] are the field operators of shrimp cultivation, and fill the role of the client. The buyer, as patron, normally buys the market ready shrimp, provides raw materials and acts as a bridge to the market as well as being a price maker or fixer. This type of a relationship develops mainly due lack of financial capital of a shrimp farmer who then depends on a buyer or a middleman with financial capital. Normally, property rights[11] would remain with the farmer. This kind of relationship represents conventional contract type transactions between the two parties involved.

The principal-agent relationship is an arrangement in which one entity legally appoints another party to act on his or her behalf (Allen, 1985; Carruthers, 1996; Helm & Wirl, 2014; Shavell, 1979). In a principal-agent relationship, the agent acts on behalf of the principal and should not have a conflict of interest in carrying out due obligations. This is a formal relationship between the investor (financial company) and shrimp farmers. The investor plays the role of financial supporter and raw material provider for the pond production, and shrimp farmers the role agent or

[10] Shrimp farm owner and the shrimp farmer who hires a pond for cultivating shrimp.

[11] The property rights of the pond(s) are still with the farmer, but when the farmer fails to repay the money that they had borrowed, in severe circumstances, this will lead to land appropriation, it depends on their debt pact. However, farmers who experience harvest failure and cannot pay their debt, usually ask for another extend time period to pay their debt.

labour provider who manages and maintains the shrimp ponds. This relationship pattern offers two systems of production sharing, either loss and profit sharing, or salary. In general, the former aims to share the risk between the farmer as field operator, and the financial provider, with the farmer having greater incentive and income if the cultivation is successful.

The third pattern is business-foster parent relationship. In Indonesia this is well known as *Tambak Inti Rakyat*-TIR (Nucleus Estate Pond Development Scheme). The TIR Scheme is a partnership between a group of farmers and a partner company (investor) in which the partner company acts as the nucleus, and the group of farmers as plasma. As the nucleus, the company partner provides most of the group farmers' needs such as financial and technical assistance, and the group of farmers are the actual producers of shrimp.

The TIR program was initiated by the Indonesian government under Presidential Decree Number 18, 1984. The TIR scheme started in 1985 with a 250 hectares pilot project in the Cipucuk village of Krawang Regency. The program also provided cold storage, a feed mill and technical assistance. A year later, a Ministry Decree was issued to standardize the TIR program. The Minister of Agriculture Decree No. 334 / Kpts / Ik 210/6/1986 regulates the rights and obligations of both parties involved in a Nucleus Estate Pond Development Scheme.[12] Based on the role of the relevant parties defined by this Decree, the TIR Scheme seems to be a combination model sitting between the patron-client model and the principal-agent model.

In the context of agribusiness, shrimp farming is linked with the supply chain system that secures shrimp fry stock, the raw material for developing and maintenance of ponds, the distribution and marketing of shrimps. The supply chain analysis

[12] TIR development program faced problems related to business maintenance and farming management programs that ended an unsuccessful program (Alie Poernomo, 2004a). Furthermore, Noor (2006) shows the main obstacles of the shrimp farmer in a Nucleus Estate Pond Development Program is the insufficient knowledge of aquaculture technique, the low capital hazard, and the price information deficiency system. Within those obstacles, were created coastal community dependencies on the investors and downgrades the social system of coastal communities (Noor, 2006) and resulted in the pond owners' and the employers' sides having a weak bargaining position.

encompasses the three following activities: procuring raw materials, producing the product, and distributing products to retailers and even to consumers directly. Traditionally, each activity connected with the supply chain such as planning, procuring, manufacturing, warehousing, and marketing have operated independently of each participant, a link in the supply chain, and each link often having their own sets of objectives that may be in conflict with other participants of the supply chain.

Spinosa, Klen, Rabelo, Camarinha-Matos, and Ferreira (1998) identify that the agribusiness supply chain consists of small and medium size enterprises such as farmers, producers of raw materials, suppliers of agricultural inputs, processors of agricultural outputs, farmers' cooperatives, brokers, suppliers, distributors, whole-salers, and retailers who either tend to operate independently or cooperatively mainly in the last stage of the supply chain, which is product distribution to the end consumers.[13]

The agribusiness supply chain as a system can experience disruptions internally and externally. Those disruptions create risks and threats. In the context of the supply chain of the shrimp industry, Lave (1990) and Morgan (1993) define a risk as any uninhibited event that creates a potential loss and damage to anywhere in the supply chain nodes, whereas Slack (2011) defines risk as a condition caused by uncertainty. From a supply chain perspective, O. Tang and Musa (2011) recognise a risk as any kind of disruption to the functioning of a supply chain process, and other unclassified factors that negatively interfere with it.

As described in the previous section on disasters, other disruptions have two dimensions as misfortunes (negative impact) and opportunities (positive impacts) (Klein, 2007) and can act as a potential barrier to, or a motivation for opportunities (O. Tang & Musa, 2011). Similarly, when facing and solving risks and threats, supply chain actors adopt risk management models in anticipating and avoiding loss.

[13] The three supply chain stages are : i) activities to obtain materials, ii) transform the material into products, and iii) distribute the products through many supply chain contributors to the end consumers (Muckstadt et al., 2001; Stadtler, 2015; Tan, 2001)

In other words, the ability in anticipating and avoiding loss is acknowledged as resilience.

Explaining resilience B. Walker, Holling, Carpenter, and Kinzig (2004) define resilience as a capacity of a system to absorb disturbance and reorganizing of undergoing change back to normal. Whereas Carl (2006) emphases resilience as a capacity to capture risks, an ability in maintaining assets, proficiency in creating opportunities and innovating for development. Adding to those definitions, Ta (2010) includes flexibility and availability of option as aspects in resilience that need to be addressed.

Based upon the above definitions, resilience has two aspects, sustaining and developing. It is possible to see that, resilience is compatible to the study of livelihood system dynamics (Carl, 2006; Ta, 2010). At this stage, the resilience concept is able to guide how livelihood system respond to insecurities, stress, and shock, whilst also maximising alternative options when seeking solutions.

Thus it is possible to portray risk management as a cyclical process that starts from identification of factors that increase a community's vulnerability, and then to continue with mapping relevant risks due to a disaster. After the mapping of assets and risks, the next phase is observing and identifying future mitigation strategies. The final phase of this process involves identifying appropriate monitoring and assessment methods. In this cyclical approach, Ho, Zheng, Yildiz, and Talluri (2015) divide risks into two categories of micro and macro. Macro risks refer to external events or situations such as disasters, terrorism, and political instability that contribute to negative impacts on companies, industries or communities. Micro risks refer to events or situations that originate from actors or organisations within the supply chain itself. Examples of micro risk are a late supply of raw material, below standard of production, or overproduction.

The hazards discussed in section 2.1 also create risks, vulnerabilities, and disruptions in the affected communities. Further, they disturb the relations among the local community members. Similarly, a disaster could also disturb the supply chains of goods and services. Moore (1983) and Omera and Bernard (2007) argue that risk

management and resilience of the supply chain are urgent measures to minimize losses and keep the pathways of distribution channels on the right track. Cousins, Lamming, and Bowen (2004) and Hendricks and Singhal (2005) highlight that a failure in managing supply chain risks can affect profit and income levels. In addition to loss or the decrease of income, failure to manage risks associated with a supply chain is also a result of poor management process (Cousins et al., 2004). Poor governance in planning and identification of risks could also create tensions and conflicts between stakeholders (Hendricks & Singhal, 2005). Consequently, business organisations have to understand the benefits of managing risks and anticipating alternative actions in reducing risks and hazards (M. A. Lewis, 2003). Therefore, failures on the part of supply chain actors in managing and identifying environmental changes create a disruption to the supply chain. Hence Larry and Reham Aly (2004) define risk management as sustained long-term processes of the members (actors) of a supply chain system. The context of anticipating and mitigating risks, especially those that are caused by disasters, are not solely the responsibility of the government or business entities, but also the responsibility of the whole community. As an integral part of risk mitigation, organised local community groups such shrimp farmer groups also need to apply risk management approaches.

In summary, supply chain risk management has been developed and is usually undertaken by individual companies to assess and manage both their micro and macro operational risks. The rational is to minimize losses and keep the pathways of distribution channels on the right track If this does not happen, and the risk is not anticipated, it can be costly in money and time to put the business back in the right direction. In this research, supply chain risk management in the shrimp industry is applied to the industry level in order to assess potential losses and risks due to pollution from disasters. The advantages of applying the supply chain risk management are similar to having an early warning system for any possible events that create vulnerability to the shrimp farmers' communities.

Applying supply chain risk management is aligned with the SLF in identifying and developing resilience. Therefore the use of supply chain risk management in conjunction with the sustainable livelihood framework in analysing and documenting

the socio-economics and ecological system of the shrimp industry is methodologically appropriate. A detailed description of this approach is in the methodology chapter.

2.4. Conclusion

This chapter reviewed the key literature establishing contemporary understandings of three concerns central to this thesis that relate to the Porong mud volcano disaster. The issues identified highlight the importance of factors that contribute to the vulnerabilities of shrimp farmers and lead to the transformation of livelihood practices and supporting structures, among the affected community members as an integral part of risk management of the shrimp farming sector in Sidoarjo. The purpose of a constructivist-interpretive framework such as the SLF helps in increasing our understanding through collaborative construction of knowledge, which is central to the thesis' objectives.

In summary, understanding the impact of a disaster, risks and agency responses to mitigate the impact of the affected shrimp farmers requires a multi-dimensional investigation. Within the disaster framework, the supply chain risk management models, and the use of the SLF as a research tool were used to help identify and analyse the multi-dimensional and multi-faceted issues that emerged after the Porong mud volcano disaster.

CHAPTER 3. OVERVIEW OF SIDOARJO SHRIMP INDUSTRIES[14]

This chapter draws on existing literature to describe the Sidoarjo district, the Sidoarjo shrimp industry and the vulnerabilities to which shrimp farmers and others are exposed. Drawing on the sustainable livelihoods literature, it discusses the environmental, economic and political conditions that contribute to economic development and which expose certain sectors and communities to new vulnerabilities.

In the context of political ecology, I utilise disaster and risk management studies to frame interactions among shrimp industry stakeholders. These interactions are important for explaining how the shrimp industry was affected by and responded to both previous declines in shrimp pond productivity and the mud volcano. The interactions among aquaculture stakeholders create opportunities for structural changes in creating sustainable agriculture.

In addition to describing the Sidoarjo district as the research location and providing a background of the Sidoarjo economy, this chapter provides a baseline summary of the state of the shrimp production industry in Sidoarjo at the point of time six years after the mud volcano eruption in Porong. Most of the discussion is based on reports internally produced by the Sidoarjo District government, especially the Department of Marine and Fisheries, and other secondary data sources.

This chapter is organised into five sections that start with an overview of the Sidoarjo society and economy with a focus on Sidoarjo aquaculture and the water system. The second section describes the structure of the Sidoarjo shrimp industry and its relationship to the regional, national and global economy. To contextualise the threat and vulnerabilities of the shrimp industry in Sidoarjo, the third section pays

[14] all currency conversions in this chapter are based on one Australian dollar equals Rp10,000

particular attention to the exposure of shrimp production in Sidoarjo to differently produced vulnerabilities over time. The fourth section discusses the documented impacts of the mud volcano on shrimp production and shrimp consumption. This section provides a deeper understanding of the vulnerability factors (the mud volcano)[15] that place the shrimp industry at risk. The final section highlights the key factors that contribute to Sidoarjo shrimp farmers' vulnerability and issues that need further investigation.

3.1. Sidoarjo at a glance

3.1.1. Sidoarjo District: social-economic overview

Sidoarjo, located south of Surabaya in the delta area of the Brantas River, is the smallest district in East Java, covering an area of 627 square kilometres. The district consists of 18 sub-districts or *kecamatan* and 353 villages or *kelurahan* (BPS Sidoarjo, 2015). Based on 2015 census data, Sidoarjo's population was 1,945,252 people (BPS Sidoarjo, 2015, p. 99).

In 2014 based on contribution to gross regional domestic product (GRDP) the manufacturing industry was the largest contributor to the Sidoarjo economy accounting for Rp61,587,406.20 million (A$6,158.74 million) or 47.05 percent of GRDP (BPS Sidoarjo, 2015). The second largest sector in the region was wholesale and retail trade, maintenance service (Rp20,810,686.00 million [A$2,081.07 million], or 15.90 percent of GRDP). The third most dominant sector in the region was transportation and warehousing. The value of Sidoarjo transportation and warehousing was Rp14,650,398.00 million (A$1,465.40 million) representing 11.19 percent of GRDP. The primary sector, agriculture, forestry and fishing by comparison contributed Rp3,126,216.50 million (A$312.62 million) or 2.38 percent of GRDP (BPS Sidoarjo, 2015).

These figures reflect a rapid rise in the value of the secondary and tertiary sectors to the district in recent times. During the decade 2000 to 2010, Sidoarjo experienced an annual economic growth rate of approximately 5.78 percent *(Tim Pelaksana*

[15] The mud volcano exacerbating existing vulnerabilities of the shrimp farmers

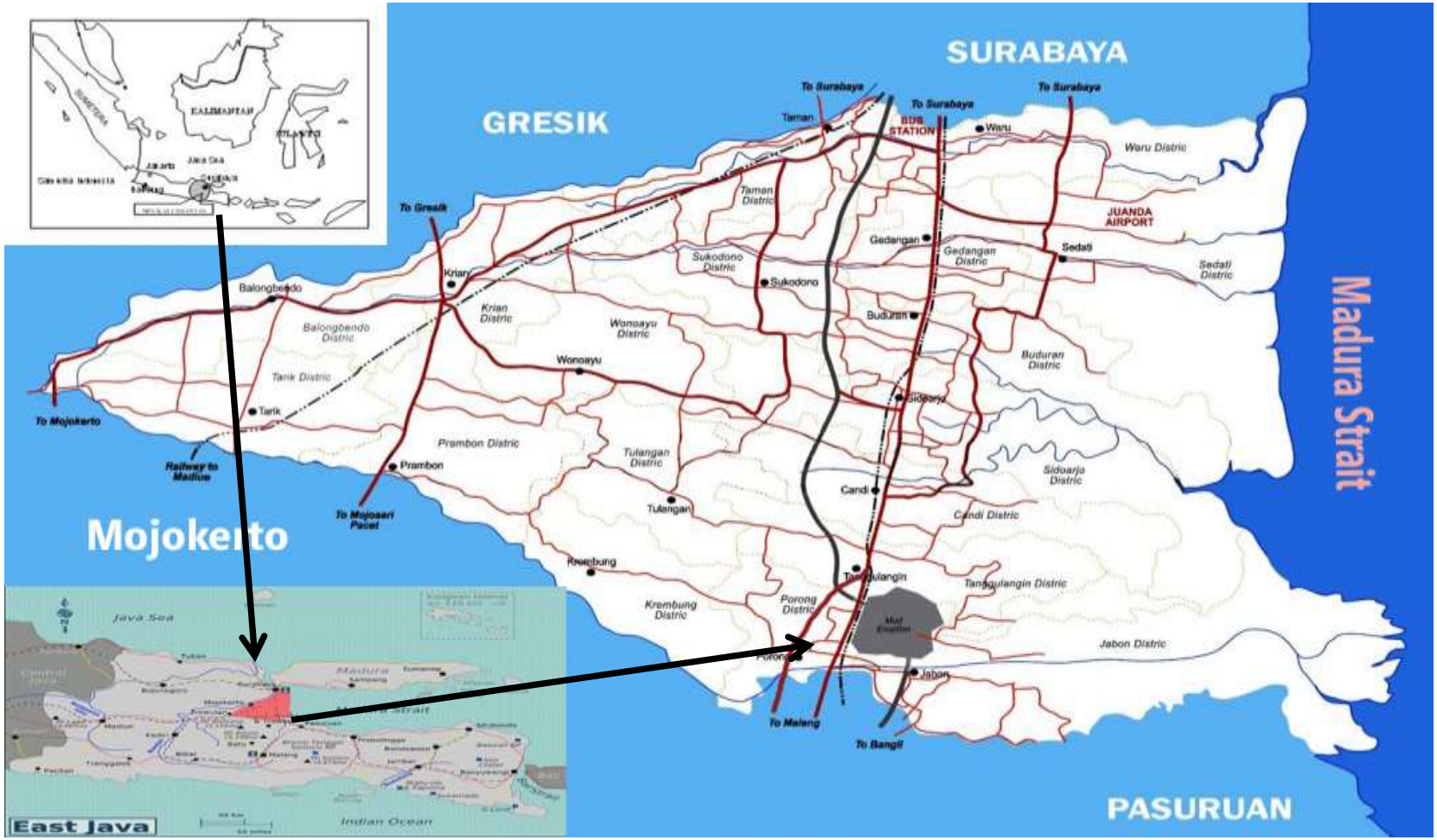
Kelompok Kerja PPSP Kabupaten Sidoarjo, 2011). The highest contribution to this growth originated from the tertiary industry sector, which grew by 39.83 percent. During the same period, the primary sector increased by 12.51 percent and the secondary sector rose by 11.66 percent . *(Tim Pelaksana Kelompok Kerja PPSP Kabupaten Sidoarjo*, 2011).

Referring to Dahuri (2006), the former Indonesian Minister of Maritime Affairs and Fisheries, the districts that are located in the Madura Strait jointly generated approximately 30 percent of the total Indonesian fisheries export market. Sidoarjo, with the other districts that are located in the Madura Strait, plays a significant role in the local fishery sector and the Indonesian fisheries export market.

The macroeconomic description above demonstrates that Sidoarjo's economy is dominated by the secondary, and increasingly, the tertiary sector. Nevertheless the contribution of the primary sector, such as agriculture, remains important. Harmonization between the sectors is critical to providing sustainable economic activity and achieving community prosperity.

Sidoarjo currently accounts for 44.6 percent or 59,039 tonnes (t) of the total East Java aquaculture production (East Java Statistical Board, 2012), and 28 percent of the total East Java brackish water fishery production (DKP East Java Province, 2011). The aquaculture ponds in Sidoarjo occupy approximately 15,530 hectares (ha) and belong to approximately 3,300 farmers across the eight sub-districts. Of these, 4,144 hectares are located in Jabon, 4,100 hectares in Sedati, 731 hectares in Buduran, 3,128 hectares in Sidoarjo, 1,032 in Candi, 497 hectares in Tanggulangin, 496 in Porong and 402 hectares in Waru (DKP Kabupaten Sidoarjo, 2012).

Figure 3.1 Sidoarjo district administrative map



Source: Sidoarjo Government (2009)

3.1.2. Sidoarjo and the Brantas River

Sidoarjo is located on the delta of the Brantas River system, one of Java's most significant river systems. The origin of the Brantas in the vast volcanic complex of Mt. Arjuno has contributed to the evolution of flood plains and delta regions that are an important food production hub. Fertile soils from volcanic eruptions and abundant water and waterways have supported trade, communication, and primary production for centuries. The Brantas River system stretches 320 km, crossing ten districts and six municipalities. Beginning in the upper regions of the river, they are Batu, Malang[16], Blitar[17], Tulungagung, Kediri[18], Nganjuk, Jombang, Mojokerto[19], Sidoarjo, and Surabaya, and parts of Pasuruan and Gresik (Hidayat, 2013; Kementrian Pekerjaan Umum, 2010; K. V. Ramu, 2004). In its lower reaches the Brantas River branches into two rivers, the Surabaya River and the Porong River, both of which drain into the Madura Strait (Hidayat, 2013; Kementrian Pekerjaan Umum, 2010; Kemper, Bhat, & Ramu, 2005; K. Ramu, 2004; Rodgers & Cai, 2004)

The Brantas has the potential volume of surface water of 13.232 billion m^3 on average per year, and 5 to 6 billion m^3 is utilized annually for all uses (Kementrian Pekerjaan Umum, 2010). The Brantas River basin provides water for an irrigated area of about 121,000 hectares out of the total rice paddy field area of 304,000 hectares in East Java province (Hidayat, 2013; Kementrian Pekerjaan Umum, 2011). The total area of fisheries ponds in the Brantas River basin is 19,583 hectares (Hidayat, 2013; K. V. Ramu, 2004; Rodgers & Cai, 2004) most of which is located near the coastal area.

The significance of the Brantas River to the Sidoarjo area is demonstrated through 28,779 hectares of rice paddy fields and 15,530.40 hectares of fishponds in Sidoarjo

[16] Malang consists of Kabupaten Malang (district) and Kota Malang (municipality)

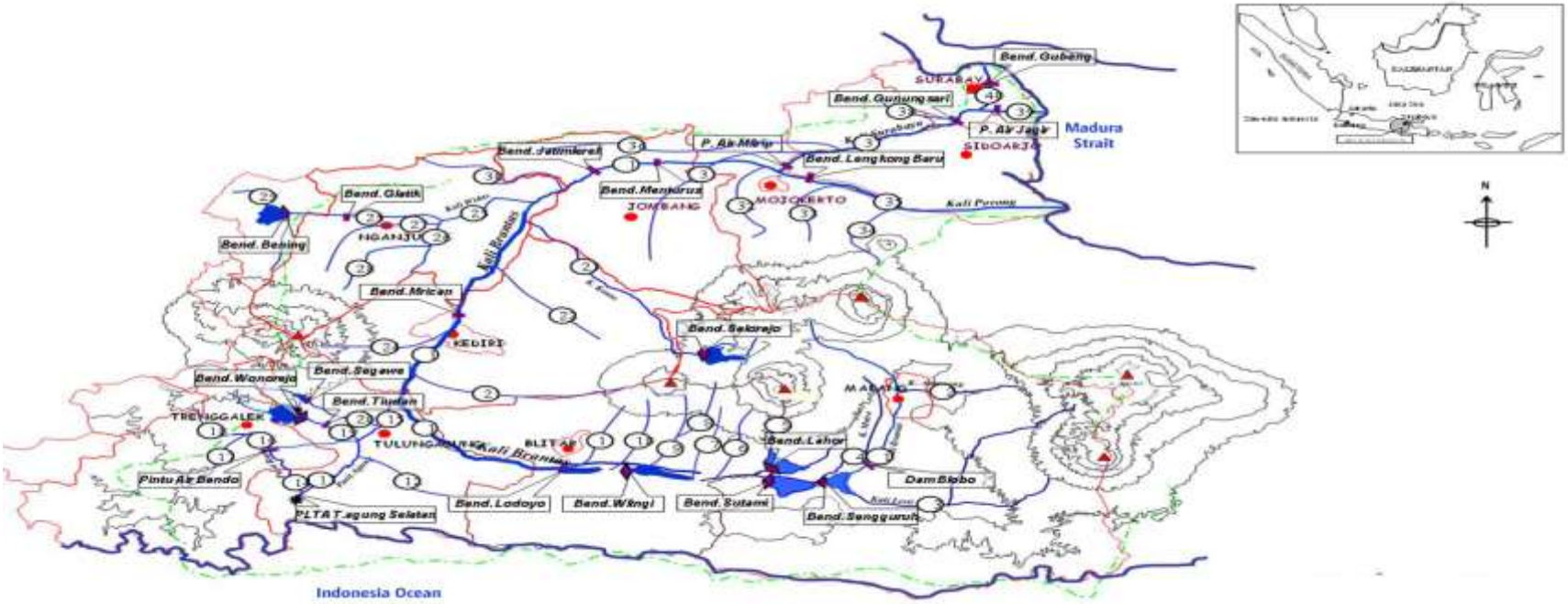
[17] Blitar consists of Kabupaten Blitar (district) and Kota Blitar (municipality)

[18] Kediri consists of Kabupaten Kediri (district) and Kota Kediri (municipality)

[19] Mojokerto consists of Kabupaten Mojokerto (district) and Kota Mojokerto (municipality)

that are dependent on the Brantas water (BPS Sidoarjo, 2015). In the Jabon subdistrict alone the Brantas provides water for more than 4,000 hectares of ponds.

Figure 3.2 Brantas Rivers System



Sources: PU, 2010 & Cahyono, 2008

3.2. Sidoarjo shrimp industry

3.2.1. Brief history of shrimp aquaculture in Sidoarjo

Shrimp aquaculture has been practised in Sidoarjo and elsewhere within Java for centuries, facilitated by favourable environmental conditions. Reference to the history of aquaculture in Indonesia started as early as 1864 when the Inspector of Agriculture, P. W. A. van Spall, reviewed 1,821 documentation on saltwater pools in Surabaya and Gresik (Schuster, 1952, p. 4). In addition, Raffles (1965, p. 156) described a brackish pond built in Gresik for "*chanos chanos"* (milk fish) cultivation based on the order of Sultan Pajang during his visit in 1568. As further evidence of aquaculture in Java, Schuster (1952) cited an old manuscript of Javanese law code "*Kutaramenawa*". This law code, dated at approximately 1400, describes the punishment for stealing fish from freshwater ponds (*siwakan*, recently well known as *kolam*) or a salt water pond (*tambak*). From these documents, it can be assumed that aquaculture in Java was operating as early as 1400 if not before.

In modern times East Java has evolved as one of Indonesia's five main centres of aquaculture along with Aceh, Central Java, West Java, and South Sulawesi. Collectively these provinces account for 93 percent of the total aquaculture area in Indonesia (Yusuf, 1995, p. 112).

Milkfish (*Chanos chanos)* was the main commodity cultivated up to 1975, after which the cultivation of tiger shrimp (*Penaeus monodon*) and white shrimp (*P. merguiensis*) became the more prevalent as they are more profitable. Shrimp attracts better prices and a wider market. However, cultivation of shrimp in polyculture with milkfish has also continued. The increased cultivation of shrimp was accompanied by new ponds and water control structures such as floodgates and irrigation channels.

Intensive cultivation methods were introduced in 1985. The 1980s were the golden era of the Indonesian "New Order" administration under the leadership of President Soeharto. During this decade Indonesia experienced rapid economic growth. The annual growth rate of Gross Domestic Product (GDP) was at 7.7 percent and never below 5 percent. This decade was a period of massive government investment occurring in many economic sectors. This included investment in the agricultural

sector, which includes the aquaculture industry, to achieve national food self-sufficiency (Tambunan, 2001).

In order to support the self-sufficiency food program of the New Order administration, the aquaculture sector was encouraged to apply intensive shrimp farming. This form of intensive cultivation reportedly provided a yield 400 percent more than traditional rice farming (Antara, 2006). Other sources declared that the price of one kilogram of tiger shrimp equated to about 25 kilograms of rice.[20] When intensive shrimp farming was encouraged, there was much land conversion to establish aquaculture ponds.[21]

Despite the current value and ongoing potential of the aquaculture industry, shrimp aquaculture has resulted in social conflict between shrimp farmers and local people living in the vicinity of shrimp farms worldwide (Páez-Osuna, 2001; Primavera, 1997). For example, both wetland conversion and agricultural land conversions to establish shrimp aquaculture have caused salinization of groundwater and soil, reduction of mangroves, and therefore broader changes in land use patterns. In 2000 intensive aquaculture in Indonesia caused an approximate reduction in the mangrove forest area of 2 percent (Antara, 2006). Páez-Osuna (2001) presented data to demonstrate that approximately 1 to 1.5 million hectares of coastal lowlands have been converted into shrimp farms, mainly in China, Thailand, India, Indonesia, Philippines, Malaysia, Ecuador, Mexico, Honduras, Panama, and Nicaragua. Furthermore, shrimp aquaculture is also considered to contribute to the release and spread of diseases and chemical substances, and to sediment disposal that causes disease outbreaks in the wild population, drug resistance among pathogens, and

[20] The main product of Indonesia, especially Sidoarjo agriculture, is Paddy (rice plant) and the staple of Indonesia is rice

[21] There are three modes of land conversion. First is conversion from the *"oloran"* land. The shrimp farmer opens a new pond by converting the land that arises through build-up of sediment in the river estuary. Second is mangrove conversion. This conversion process transfers the function of the area from mangrove to new pond. Mangrove conversion costs a lot of money to pay workers to clear land and a fee for local government planning approval. The last conversion process is changing rice fields into shrimp ponds. The Marine and Fisheries Department of Sidoarjo Regency had little data about the development of the aquaculture area in Sidoarjo.

unknown effects on non-target organisms in delicate coastal areas (Páez-Osuna, 2001; Primavera, 2006).

Another cause of local social disruption due to shrimp aquaculture is excessive use of water for shrimp aquaculture. This creates competitive rivalry among the water users (Páez-Osuna, 2001; Primavera, 1997). Further, according to Neiland, Soley, Varley, and Whitmarsh (2001) shrimp aquaculture has a potential to create marginalisation of the rural poor, increasing landlessness of community members with land ownership centralised to one rich person, increasing poverty, and diminishing food security. It may contribute to the process of transfer of wealth to elite community members.

3.2.2. Shrimp Production

In Sidoarjo, traditional farming techniques predominate. Approximately 80 percent of shrimp farmers use traditional techniques, also known as extensive techniques, in running their aquaculture business, whereas the remaining 20 percent apply semi intensive techniques (The East Java Province Communication and Information Departement, 2014).[22]

Annually, Sidoarjo produces approximately 8,127 t of shrimp valued at Rp108,710 billion (A$108.7 million). From 2006 to 2013 tiger shrimp (*Penaeus monodon*) dominated shrimp production in Sidoarjo. In 2014 white shrimp (*Penaeus vannamei*) production increased in the same period but from a much lower base. Other shrimp production was 1,780 t in 2006 and rose to 5,559 t in 2010, then from 2010 declined to 4,002 t in 2011 and the negative trend continued to 2014. In 2014 other species of shrimps' production was 3,321 t. Reasons for the white shrimp domination in 2014 and the decline of other shrimp production are discussed in chapter six.

[22] Semi-intensive shrimp aquaculture is a shrimp cultivation method that involves stocking densities beyond those that the natural environment can sustain without additional inputs. This method requires water pump support to exchange up to 25 percent of pond volume daily (Accenture, 2013)

Table 3.1 Sidoarjo shrimp production 2006-2014 in tonnes

NO	Commodity /Years	2006	2007	2008	2009	2010	2011	2012	2013	2014
1	**Tiger Shrimp**	3,587	3,515	3,448	3,466	3,726	3,783	3,913	3,938	4,010
2	**White Shrimp**	-na	108	163	188	1,406	1,677	2,445	2,722	4,177
3	**Other Shrimps**	1,780	1,782	1,520	1,500	5,559	4,002	3,802	3,602	3,321
	Total	5,367	5,405	5,132	5,154	10,691	9,461	10,161	10,262	11,508
	Production Growth		0.71	-5.05	0.43	107.43	-11.51	7.40	0.99	12.14

Source: DKP Sidoarjo, 2015

On a provincial scale, no individual species data is available for shrimp culture production. Table 3.2 shows aggregated East Java shrimp production from 2006 to 2012. For this period the average increased rate of total shrimp production was 17.07 percent . In 2007 to 2008 East Java shrimp production experienced negative production growth of -1.82 percent , but this mostly related to sea shrimp.[23] On average, from 2006 to 2012, East Java shrimp production grew at approximately 24.6 percent per year. In the same period East Java shrimp culture production achieved an average growth of approximately 35 percent annually.

Table 3.2 East Java shrimp production 2006-2012, in tonnes

Commodity /Years	2006	2007	2008	2009	2010	2011	2012
Sea shrimp	8,971	10,231	8,623	8,514	8,325	9,075	8,501
Freshwater shrimp	568	436	461	630	652	485	424
Shrimp Culture	22,065	27,075	27,972	38,730	50,643	50,489	69,385
Total shrimp production	31,604	37,742	37,056	47,874	59,620	60,049	78,310

Sources: The Indonesian Marine and Fisheries Ministry, 2013

[23] Shrimp that are caught in the ocean as wild shrimp

Table 3.3 Indonesian shrimp production 2006-2012, in tonnes[24]

Commodity /Years	2006	2007	2008	2009	2010	2011	2012
Giant River Prawn (*Macrobrachium Rosenbergii*)	1,199	989	942	696	1,327	617	4,430
Banana Prawn (*Penaeus Merguiensis*)	36,187	16,995	32,143	22,365	16,424	10,757	13,128
White leg Shrimp (*Penaeus /Litopenaeus Vannamei*)	141,649	164,466	208,648	170,969	206,578	246,420	238,663
Giant Tiger Prawn (*Penaeus Monodon*)	147,867	133,113	134,930	124,561	125,519	126,157	116,311
Meta Penaeus Shrimp Nei	14,000	15,500	32,548	19,120	30,804	16,194	375
Blue Shrimp			77		2	16	
Total	340,902	331,063	409,288	337,711	380,654	400,161	372,907

Sources: FAO (2012)

[24] The data of Giant River Prawn and *Meta Penaeus* shrimp in 2001-2012 has a huge difference. However, as the focus of this research is for the commodities that are cultivated by Sidoarjo shrimp farmers, *Panaeus Vannamei* and *Penaeus Monodon*, those two production anomalies are not discussed.

Nationally, Indonesia's shrimp production rose by 6.35 percent per year from 2005 to 2009. The volume of shrimp production in 2005 was 280,629 t and this increased to 380,972 t in 2010. Other than in 2006, annual Indonesian shrimp production was dominated by white shrimp (*Penaeus vannamei*) at 53.2 percent of the total shrimp production, followed by tiger shrimp (*Penaeus monodon*) at 35.59 percent of total shrimp production. On average, from 2006 to 2012 the Indonesian annual production of white shrimp increased by 10.31 percent, whereas the annual production of tiger shrimp declined by 3.8 percent.

Comparing the data that depicted on Table 3.1,Table 3.2, and Table 3.3 shows that Sidoarjo has a very small contribution to the National shrimp production. However, this sector still has a significant role in supporting regional economic activities of Sidoarjo

3.2.3. The Sidoarjo shrimp industry market

This section describes the demand for Sidoarjo shrimp products in the local, regional, national and international markets. It draws on existing data on the local, regional and national shrimp consumption levels in Indonesia to provide an indication of demand for Sidoarjo shrimp.

3.2.3.1 **Domestic market**

The estimates of the shrimp domestic market provided in this section are based on data gathered from Virgantari, Daryanto, Harianto, and Kuntjoro (2010) who investigated the food expenditure patterns of Indonesian households including the budget allocated for shrimp consumption.

They found that Indonesians spend about 50.17 percent of their income on food and 7.9 percent on fish. The budget allocation for fish further is divided into 55 percent spent on fresh fish, 40 percent for preserved fish including frozen and dried fish, and just 4 percent for fresh shrimp and 1 percent for preserved shrimp. In short, Virgantari et al. (2010) estimated that Indonesians allocate only 0.0018 percent of

their total income to purchase shrimp and that expenditure on shrimp is equal to 5 percent of total expenditure on fish.

According to the Indonesian Marine and Fisheries Ministry (2014), Indonesians' fish consumption level was 25 kg per capita per year in 2007 and increased to 38.67 kg per capita per year in 2014, a 55 percent increase over seven years. This trend has been shown in Table 3.4.

Table 3.4 Per capita per year Indonesians' fish consumption level

2007	2008	2009	2010	2011	2012	2013	2014
25 kg	29.98 kg	30.17 kg	30.48 kg	31.64 kg	34.78 kg	35.14 kg	38.67 kg

Source: KKP, 2014

The fish consumption rate analysis of the total population is estimated through a calculation of the total demand of fish production. The annual fish consumption level is based on the population growth trend multiplied by the per capita fish consumption. The population growth trend is shown in Table 3.5, based on the demographic data from the 2000 census and 2010 census. The annual fish consumption is obtained by multiplying the per capita fish consumption (Table 3.4) and the population (Table 3.5). The result is the calculated annual fish consumption depicted in Table 3.6.

The fish consumption level of Indonesia, East Java Province and Sidoarjo District from 2007 to 2014 is shown in Table 3.6. At the national, provincial and district level fish consumption increased approximately 8.46 percent per year over this period.

Table 3.5 Indonesia, East Java, and Sidoarjo Population

	2000 Census	2010 Census	Population Growth trend
Indonesian Population	206,264,595	237,641,326	1.49 percent
East Java Province's population	34,783,640	37,476,757	0.78 percent
Sidoarjo Population	1,563,015	1,945,252	0.49 percent *)

Sources: Indonesian Statistical Board (2015) *) Data from Sidoarjo Statistical Board (2012)

The shrimp consumption level is derived from the multiple of the percentages obtained from the annual reports of the Director General of Aquaculture (2013) and Virgantari et al. (2010) research (shrimp being 5 percent of the total fish consumption level) (Table 3.5). The shrimp consumption levels are provided in Table 3.7.

Table 3.6 Indonesia, East Java and Sidoarjo fish consumption levels (tonnes) 2007-2014

Year	Indonesia	East Java Province	Sidoarjo
2007	5,719,097	918,196	40,436
2008	6,960,530	1,109,690	48,728
2009	7,109,012	1,125,433	49,277
2010	7,243,308	1,142,292	59,291
2011	7,631,004	1,195,014	61,849
2012	8,513,302	1,323,855	68,321
2013	8,729,583	1,347,990	69,366
2014	9,749,653	1,494,974	76,708

Sources: KKP (2014); Indonesian Statistical Board (2015); Sidoarjo Statistical Board (2012),

It is relevant to compare the shrimp consumption level to the shrimp production quantity nationally, regionally and locally. From Table 3.7 the average annual shrimp consumption in Sidoarjo in the period 2007 to 2014 is 2,962 t. From Table 3.1the annual shrimp production in Sidoarjo over the same period is 8,127 t (DKP Kabupaten Sidoarjo, 2011). From this comparison, the local Sidoarjo market absorbs approximately 36 percent of Sidoarjo's shrimp production while 64 percent of Sidoarjo shrimp product is marketed outside Sidoarjo, either regionally, nationally or internationally.

From Table 3.7 the average annual demand for shrimp in East Java in the period 2007 to 2014 is 60,359 t. From Table 3.2 the average annual shrimp production in East Java in the period 2006 to 2012 is approximately 50,322 t. There is a deficit of approximately 10,000 t. This means that East Java's demand for shrimp cannot be fulfilled by its own shrimp production. The shrimp production deficit that has been experienced by East Java Province demonstrates the importance of external shrimp suppliers.

Table 3.7 Indonesia, East Java and Sidoarjo Shrimp consumption (tonnes) 2007-2014

Year	**Indonesia**	**East Java Province**	**Sidoarjo**
2007	285,954.85	45,909.81	2,021.78
2008	348,026.52	55,484.48	2,436.39
2009	355,450.62	56,271.63	2,463.85
2010	362,165.381	57,114.58	2,964.56
2011	381,550.21	59,750.68	3,092.47
2012	425,665.12	66,192.73	3,416.03
2013	436,479.13	67,399.52	3,468.30
2014	487,482.64	74,748.69	3,835.41

Sources: analysed secondary data from the Indonesian Statistical Board, 2015; KKP, 2014

On a national scale, based on the data obtained from the FAO Fishery and Aquaculture Statistics 2012 the Indonesian average total shrimp production is 367,527 t. [25] From Table 3.7, Indonesia's average shrimp consumption level from 2007 to 2012 is 359,802 t. According to the Ministry of Marine and Fisheries, the domestic market absorbs 85 percent of national fish production (Fadli, 2012), which means that the domestic market plays a significant role. The domestic market includes seafood processing factories, small businesses such as crackers and shrimp paste companies, restaurants and households.

3.2.3.2 **Global market**

The FAO Fishery and Aquaculture Statistics 2012 show that world shrimp production was 3,163,968 t in 2006 and increased on average from 2006 until 2012 by 10.6 percent annually. The largest annual growth occurred between 2010 to 2011 of 11.05 percent. The average annual production over 2006-2012 of the six shrimp commodities is 3,717,306 t. A comparative analysis of shrimp exporting countries shows that Indonesia contributes around 9.9 percent of total world shrimp production. Indonesian shrimp is mostly exported to Japan, the United States, and the European Union. Table 3.8 provides statistics on Indonesia's shrimp exports.

Globefish (2015a) identifies the ten largest importers of shrimp globally are the European Union (EU), the United States of America (USA), Japan, Vietnam, the Republic of Korea, China, Hong Kong SAR, Mexico, Canada and Australia. These ten buyers of world shrimp imported 1.3 million t of shrimp from January to September 2014, an increase of 8 percent or 100 000 t more than in the same period of 2013.

However, the increased shrimp consumption has not occurred in Japan, Hong Kong, and Canada, (Globefish, 2015b). The decline of Japanese shrimp imports was due to the decreasing value of the Yen, making the import prices higher compared to 2013 (Globefish, 2015b).

[25] Table 3.3 - average of total shrimp production 2006 to 2012

There were three main shrimp suppliers to the Japanese market in 2014: Vietnam (34 477 t), Thailand (25 857 t) and Indonesia (21 929 t) beside cold-water shrimp imported from Argentina and Russia (Guilbault, 2015; Thu, 2014). Based on the data from the Indonesian Statistics Board (2014), Japan is the main destination of Indonesian shrimp.

Besides Japan, the USA is one of the biggest shrimp importers worldwide. Due to an early mortality syndrome that occurred in Thailand's export shrimps, India became the main shrimp supplier to the USA market in 2013. Apart from India and Thailand, the USA also imported shrimp from Indonesia, Vietnam, Ecuador and Mexico. In 2014 and 2015, Indonesia overtook Ecuador, Vietnam and Thailand to become the second-largest supplier of shrimp to the US, after India (Ramsden, 2016). For 2006-2013, the Indonesian average annual shrimp export to the USA was 52,560.88 t, reaching a peak of 64,520.60 t in 2013.

Table 3.8 Indonesian shrimp exports by destination, 2006-2013 (tonnes)

Destination	2006	2007	2008	2009	2010	2011	2012	2013
Japan	49,762.30	39,816.30	37,666.80	35,060.70	32,669.40	31,000.20	32,497.60	32,943.70
United States of America	46,968.10	48,386.20	57,692.70	45,213.60	43,560.90	55,007.00	59,137.90	64,520.60
European Union	25,529.90	23,035.30	20,594.50	16,165.50	12,480.50	9,449.50	5,630.70	6,165.60
China and Hong Kong	8,496.90	6,956.50	10,186.70	5,521.20	10,196.50	9,309.90	9,093.30	8,265.50
Malaysia	3,893.20	5,755.00	4,247.10	3,394.50	2,895.60	2,801.30	2,593.70	2,959.10
Singapore	3,362.40	2,536.70	2,039.30	2,948.70	2,238.70	2,280.60	2,979.90	3,137.20
Australia	1,631.80	653.60	479.60	421.50	220.30	562.70	752.70	895.80
Other Countries	6,453.10	7,648.60	7,961.30	8,367.70	9,675.10	9,417.20	10,213.00	8,099.40
Total Export	146,097.70	134,788.20	140,868.00	117,093.40	113,937.00	119,828.40	122,898.80	126,986.90

Sources: BPS, 2014

After Japan and the USA, the EU is the third largest market that absorbs Indonesian shrimp. The average annual EU import of shrimp from Indonesia was around 14,881.44 t. However, the demand for Indonesian shrimp has declined rapidly since 2009. The EU reduced its imports from 20,594.50 t in 2009 to 6,165.60 t in 2013. In general EU shrimp imports decreased by 3.8 percent in 2013 and internal shrimp supply among the EU members also decreased around 4 percent in comparison to 2012 (Globefish, 2015a).

Additionally, Globefish (2015a) described the Asian market, especially Vietnam, the Republic of Korea and China, as a major market for imported shrimp. For the Indonesian shrimp market, China and Hong Kong are the fourth biggest export destinations.

Malaysia and Singapore are also significant markets for Indonesian shrimp production. On average from 2006 to 2013 these countries imported around 3,567.438 t and 2,690.438 t respectively from Indonesia (FAO, 2014). From the description above, it can be seen that Indonesia is one of the significant shrimp suppliers worldwide.

Table 3.9 The six commodities of Global Shrimp Production 2006-2012 in tonnes

	2006	2007	2008	2009	2010	2011	2012
Giant River Prawn (*Macrobrachium Rosenbergii*)	189,075	226,816	219,137	224,016	201,499	204,949	220,254
Banana Prawn (*Penaeus Merguiensis*)	79,034	63,448	43,724	64,630	19,821	14,002	16,266
White Leg Shrimp (*Penaeus /Litopenaeus Vannamei*)	2,121,152	2,348,584	2,311,480	2,429,151	2,713,593	3,100,970	3,178,721
Giant Tiger Prawn (*Penaeus Monodon*)	641,280	593,649	720,365	769,139	684,999	796,925	855,055
Meta Penaeus Shrimp Nei	130,751	140,403	151,940	88,264	188,844	107,182	132,998
Blue Shrimp	2,676	2,397	2,567	2,223	15,222	1,929	2,014
World Total	3,163,968	3,375,297	3,449,213	3,577,423	3,823,978	4,225,957	4,405,308

Sources: (FAO, 2014)

3.3. Vulnerability factors affecting shrimp production in Sidoarjo

After demonstrating the shrimp production and the Sidoarjo shrimp market locally, regionally, nationally and globally, this section discusses the vulnerability factors that influence shrimp aquaculture in Sidoarjo. The shrimp culture development process has constraints and problems. As discussed in chapter one, the mud volcano in Porong affected shrimp aquaculture production. This section will discuss four other factors that are constraints and problems in Sidoarjo shrimp production.

3.3.1. Substantial loss of shrimp before the mud volcano in 2006

Before the mud volcano in Porong there was a large shrimp death occurrence in 1994. Some experts considered that this failure happened because of mismanagement of pond production, and high pollution.

According to Bhattacharya et al (2011), the mismanagement of pond production was caused by two factors: mangrove deforestation and the introduction of shrimp feed and antibiotics. These two factors are elements of intensive aquaculture practices. In intensive aquaculture maximization of production involves the clearing of surrounding mangroves to create space for larger shrimp cultivation ponds. Furthermore, intensive aquaculture used what are now considered to be inefficient feeding methods and overuse of antibiotics. As a result, farmers were spending almost 60 percent of their production costs on shrimp feed and antibiotics. However, almost 25 percent of the feed was not consumed by shrimp and settled on the bottom of the pond (P. Bhattacharya & Ninan, 2011). This condition had extensive adverse effects when the pond disposal waste system was not appropriately managed, causing mangrove pollution and river silting. The build-up of food and antibiotics re-entering the next round of shrimp production caused highly contagious disease, resulting in the widespread death of shrimp in many areas. (P. Bhattacharya & Ninan, 2011) (Páez-Osuna, 2001).

A Poernomo (1990), Hanafi and Ahmad (1999) and Siregar (2007) concur, adding that ponds overlapping due to poor construction also resulted in loss of shrimp production capacity.

Another cause of substantial loss of aquaculture before 2006 was industrial waste pollution in the Brantas River. According to Siregar (2007), some Brantas River branches, such as the Buntung, Gedangan, Kedungguling, and Porong Rivers, had high levels of polluting materials. The polluted water carried many diseases, bacteria, and other germs. These bacteria and germs were mostly living and growing in irrigation channels or rivers. Many disease-carrying bacteria grew in irrigation channels before flowing into the ponds. Barokah (2011) found that external factors such as pollution have contributed significantly to the declining quality of shrimp production.

Siregar (2007) revealed that failures of shrimp crops extended to 9000 hectares of ponds or almost 60 percent of all shrimp ponds in Sidoarjo. He reported approximately Rp13 billion losses as a result of this harvest failure (Siregar, 2007).

3.3.2. The return to traditional production methods

In 1992 before the massive failure of the shrimp harvest in Sidoarjo in 1994, Alter Trade Japan (ATJ) conducted an aquaculture survey[26] in Sidoarjo. ATJ is a company that was established by five consumer cooperatives servicing 1.5 million consumers in Japan (ATJ, 2006; Lebel et al., 2002). In 1992 ATJ developed a partnership with local processors and started importing eco shrimp products from Sidoarjo. Since 1986, consumer concern about the environmental effects of shrimp production and biosecurity concerns had grown (Lebel et al., 2002).

One year after the ATJ survey, an agreement was made with the farmers' association Ali Ridlo Group (ARG)[27]. ARG was founded around 1984. It started as a club of shrimp farmers and pond operational managers and eventually became a collector and supplier of shrimp for some export-oriented factories. ARG has a network of

[26] The aim of the survey was to identify a potential area that could supply good quality shrimp for the Japanese market

[27] This farmer group was led by Ali Ridlo and had 176 members that managed 592 ponds in five sub districts: Sedati, Buduran, Sidoarjo, Candi and Tanggulangin.

upstream and downstream activities that help connect farmers with many shrimp exporting companies. After the agreement was made ATJ started to be supplied by Sidoarjo shrimp farmers and the Sidoarjo shrimp industry experienced major changes to its cultivation methods.

After eight years of joint cooperation, ATJ started a project in Sidoarjo called the Organic Shrimp Project in Indonesia. To support the project ATJ established a local office in Surabaya in July 2000. In 2001 the farmers' association and ATJ formed a working group. The role of this group was to formulate standards of preparation and other measures required to receive organic certification; for example, when a farmer removes a mangrove the farmer must be able to calculate the amount of replacement mangrove trees to be planted. Following the work of the working group an initial inspection was conducted by Naturland[28] of Germany as part of the process to obtain organic certification.

A year after the Naturland inspection, in 2002, Sidoarjo shrimp farmers, with the assistance of ATJ, obtained an organic certification from Naturland. The benefit of having organic certification was that for every kilogram sold the farmer receives a premium price. These premium prices were split three ways: 50 percent to the owner, 30 percent for the supervisor and 20 percent for the workers (Sahidhir, 2010). However, in May 2008, the organic certification expired and was not renewed.[29]

A benefit offered by the joint cooperation between Sidoarjo shrimp farmers and ATJ was that the Sidoarjo shrimp farmers who were previously practicing intensive aquaculture methods were keen to adopt and practice cultivation methods that were

[28] Naturland is an organic certification body with headquarters in Germany. Naturland has several standards for organic agricultural products.

[29] There is no official information able to be obtained about these issues, however this research indicates that there are two perspectives about the reason why the organic certification was not renewed, first there was a moral hazard practice among members of the organic shrimp producers that mixed the organic products and non organic products in the harvesting process and caused production standards to fall. Second, based on the farmers' information, one of the official staff of the importer company (ATJ) conducted unfair purchasing practices:, farmers sold their shrimp to this official and this person resold the shrimp to the importer company. This practice occurred over several yearscausing distrust between the company and the shrimp community.

more environmentally friendly. Even though in recent times Sidoarjo shrimp has no organic certification there are many farmers still practicing organic cultivation methods. This is because the principles of the organic cultivation process and traditional cultivation processes have many similarities. This dynamic is examined more closely in chapter five

Sidoarjo shrimp production also follows the guidance and standards created by the Minister of Marine Affairs and Fisheries through Decree No. KEP.02 / Men / 2007 about CBIB (*Cara Budidaya Ikan yang Baik - A good method in aquaculture*). CBIB is a method of maintaining, cultivating, and harvesting aquaculture in a monitored location (Ministry of Marine and Fisheries of Indonesia, 2014). This approach assists in providing food that is safe and sustainable through maintenance of appropriate sanitation. Safe food means food that is free from inappropriate medical additives, dangerous chemicals, and biological substances. This method and procedure are standardized through CBIB certification and overseen by the Director General of Aquaculture within the Indonesia Ministry of Marine Affairs and Fisheries. CBIB is the technical guidance that was developed to fulfil the national standard for production in aquaculture (Government Decree Number 102, 2000) and the Government Regulation in Nutrition Quality and Safety (Government Regulation No. 28, 2004).

3.3.3. Water pollution

In 2011 the Sidoarjo Environment Agency analysed water samples from 11 locations from small rivers such as Avoer Pelayaran Buduran, Sekardangan, Buntung, Kemambang, Kedunguling, Mangetankanal, Ketintang Pucang and Sidokare. Those rivers flow and contribute to the pond watering system in Buduran, Sidoarjo, Sedati and Candi sub districts. The results showed that 40 percent of water samples were contaminated by industry waste and 60 percent by domestic waste effluent (Humas DPRD Sidoarjo, 2012). Laboratory analysis concluded that the water tested had C pollution levels, which categorizes the Sidoarjo rivers as ‘lightly polluted’ (Humas DPRD Sidoarjo, 2012).

Another water study was the Setiawan Report for Antarajatim (2012). This report assessed Sidoarjo residents' compliance regarding river pollution. The pollution that was found included foams and odors from the rivers, browning of the water, and an increase in visible pollution as the water receded. This phenomenon has been reported from Jenggala River in Sidoarjo sub district. The upstream of the Jenggala River starts in Mangetankanal (the Brantas River branch) in the Balongbendo sub district, flowing and crossing several subdistricts and ending in the Madura Strait.

Pollution has also been reported in the Candi River, including sighting of muddied gray water, which is slimy and odorous. Furthermore, the death of large numbers of fish in the Candi River was suspected to have been the result of pollution from factories (specifically a sugar factory) located along the river. This phenomenon was identified along the river flow in the Bligo Village, Kecamatan Candi Sidoarjo (Suryanto, 2012). Beside industrial pollution in Sidoarjo, in Watersari, Balongbendo residual waste from cow manure was also found to be polluting the rivers. As a result of the manure, the river water had changed color to a reddish yellow and became odorous (Imam S, 2012). From the evidence above, the Sidoarjo Rivers are polluted not only by industries but also by domestic activities before and after the mud volcano in Porong and these mechanisms of pollution are ongoing.

3.3.4. Pond reduction

The third factor influencing shrimp farm productivity is the reduction of pond capacity due to decisions to farm other species or land use changes. Based on data from the Department of Fisheries and Marine Affairs of Kabupaten Sidoarjo (DKP Kabupaten Sidoarjo, 2011, 2012), pond capacity did not change between 2005 and 2010. During that period, the Sidoarjo ponds had an overall capacity of 15,530.41 ha. In 2011 there was a slight reduction to 15,488.07 ha. Based on the preliminary research[30] there are some villages that did not engage in shrimp farming for the five years 2008 to 2013 due to three reasons. First, they assessed that it was more economical to cultivate milkfish (*Chanos chanos SP*) as a monoculture. This

[30] Research preparation while waiting issue of ethics approval.

occurred in Banjar Kemuning Village and Tambak Cemandi Village located in Sedati Sub-district. Secondly, there were industrial developments that made use of brackish water ponds for factory developments, warehouse locations and housing areas. This finding indicates a shift from pond to industrial land uses in the Tambak Sawah Village in Waru sub-district. Approximately 420.34 hectares of ponds underwent a change of land use to housing or warehouses in nine villages in Sidoarjo (BPS Sidoarjo, 2014). Those nine villages are Plumbon, Kalang Anyar, Prasung, Sawohan, Rangkah Kidul, Bluru Kidul, Cemandi, Kwangsan, and Kemiri. Of those villages, Prasung village's larger ponds have been converted to housing and industrial areas covering 107.34 ha, followed by Sawohan converting 105.89 ha. Rangkah Kidul village with smaller size ponds also has been converted to housing and industrial areas covering only 2.07 ha.

Table 3.10 Sidoarjo aquaculture ponds capacity 2009-2011

No.	Subdistrict	2009 (Ha)	2010 (Ha)	2011 (Ha)
1	Tanggulangin	496.64	496.64	496.64
2	Waru	402.2	402.2	488.34
3	Porong	496.32	496.32	450.39
4	Jabon	4144.07	4144.07	4144.07
5	Sedati	4100.5	4100.5	4077
6	Buduran	1731.16	1731.16	1528.02
7	Sidoarjo	3127.87	3127.87	3271.96
8	Candi	1031.65	1031.65	1031.65
	Total	15530.41	15530.41	15488.07

Sources: DKP Kabupaten Sidoarjo (2011)

3.4. Discussion

Geographically, Sidoarjo has several advantages as a location for shrimp ponds. First, it is located in the delta of the Brantas river system that arises from several volcanic mountains including Mt Arjuno, Mt Kelud and Mt Penangungan. These delta areas are very fertile and good for aquaculture. Second, Sidoarjo's position is near the seaport at Surabaya and the International airport at Juanda. Access to

adequate transportation and communication infrastructure makes this region well located for aquaculture trade.

In 2014 agriculture, forestry and fishing in Sidoarjo contributed Rp3,126,216.50 billion (A$312.62 million) or around 2.38 percent of GRDP (BPS Sidoarjo, 2015). Specifically, the fisheries sector contributed approximately 1.46 percent of total Sidoarjo GRDP (BPS Sidoarjo, 2015). The sector employed 8,684 people from 2004 to 2010, equivalent to more than 0.44 percent of Sidoarjo population (BPS Sidoarjo, 2015). When the aquaculture industry was linked to other industries such as food industries (restaurants, cracker factories) or people who have businesses distributing aquaculture products, the occupational dependency on this sector is more significant.

However, the advantages and benefits of this sector also face several threats. The pollution itself has become a latent danger. Further the mud volcano in Porong predominantly affected this sector.

Table 3.11 Annual growth of Sidoarjo, East Java, and Indonesia Shrimp consumption (tonnes) 2008-2014

Year	Indonesia	East Java Province	Sidoarjo
2008	21.71	20.86	20.51
2009	2.13	1.42	1.13
2010	1.89	1.50	20.32
2011	5.35	4.62	4.31
2012	11.56	10.78	10.46
2013	2.54	1.82	1.53
2014	11.69	10.90	10.58

Source: Analysis of Table 3.7

Table 3.11 shows the annual growth in consumption based on the data in Table 3.7. The growth of shrimp consumption fluctuates in this period. The highest increase in Sidoarjo shrimp consumption was 20.51 percent in 2008 and the lowest increase was

1.13 percent in 2009 followed by a dramatic increase of 20.32 percent in 2010. The highest increase in East Java shrimp consumption was 20.86 percent in 2008 and the lowest increase was 1.42 percent in 2009 followed by gradual increases from 2010 to 2011. Indonesia's national shrimp consumption follows a similar trend to East Java.

While Sidoarjo, East Java and Indonesian shrimp consumption levels did not decline, the fluctuation of consumption levels correlates with the mud volcano eruptions during 2007 to 2009 that became national news. Large news agencies such as the *Jawa Pos* Group, Kompas Group, and several other broadcast companies rapidly reported the mud volcano's eruptions and the spread of poisonous mud. Therefore the massive news media reporting on the mud volcano influenced shrimp consumption locally, regionally and nationally. In 2013, there was a slowing of shrimp consumption at all levels that correlated with the inflation rate that hit up to 8.38% (Satyagraha, 2014).

Table 3.12 Indonesian shrimp export destinations, 2007-2013

Destination	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Japan	-24.98	-5.71	-7.43	-7.32	-5.38	4.61	1.35
The USA	2.93	16.13	-27.60	-3.79	20.81	6.99	8.34
European Union	-10.83	-11.85	-27.40	-29.53	-32.08	-67.82	8.68
China + Hongkong	-22.14	31.71	-84.50	45.85	-9.52	-2.38	-10.02
Malaysia	32.35	-35.50	-25.12	-17.23	-3.37	-8.00	12.35
Singapore	-32.55	-24.39	30.84	-31.71	1.84	23.47	5.01
Australia	-149.66	-36.28	-13.78	-91.33	60.85	25.24	15.97
Other Countries	15.63	3.93	4.86	13.51	-2.74	7.79	-26.10
Total Export	-8.39	4.32	-20.30	-2.77	4.92	2.50	3.22

Sources: Analysed from table 3.6 BPS, 2014

At the international level, in the period 2006 to 2010 exports show a negative trend particularly in the European and Japanese markets. Table 3.8 shows the main export destinations for Indonesian shrimp from 2006 until 2013. Table 3.12 shows that most of the Indonesian exports in 2006-2013 experienced negative growth. Since the

implementation of the European Food Safety Regulation 178/2002, the Japanese Ministry Notification No. 370 of the Ministry of Health, Labour and Welfare, "Standards and Criteria for Food and Additives" and FAO Regulation on Maximum Residue Limits, shrimp exports are subject to more rigid standards worldwide. From 2007 to 2011 Indonesian shrimp export to Japan experienced negative export growth[31]. The European Union market also had negative export growth from 2007 to 2012 and the Australian market had negative export growth from 2007 to 2010. The negative trend of Indonesian shrimp export coincided with the mud volcano in Porong and the rise in attention to food-bio security issues such as pollution and the use of hormones and antibiotics in aquaculture. International demand for Indonesian shrimp, after experiencing negative growth from 2006 to 2010 returned to positive growth from 2011 to 2013.The ties between environmental conditions and management practices are clear in these trends, particularly in the domestic Indonesian market. In Sidoarjo the development of a good reputation due to eco-shrimp production has been very important. Eco-shrimp products are safe with high quality and require sustainability values in cultivation. There is also the potential to develop allied activities like aquaculture tourism or delta river tourism.

Aquaculture development requires a conducive political environment and appropriate economic and social policies. In this regard, transparency in decision making, good communication, coordination and support across sectors and other stakeholders are important preconditions. There are high expectations of the sector. Based on the strategic planning document of the Ministry of Marine and Fisheries of Indonesia 2015-2019, the state would like to improve the welfare of aquaculture stakeholders (particularly fish farmers), contribute to non-oil exports, reduce poverty, and absorb the national workforce. This would increase its contribution to the Indonesian economy, create national economic growth and increased foreign exchange, increase the average income of the participants and increase the sector's contribution to GDP

[31] The decline export in one of the main shrimp export destination did not affect the local shrimp consumption, this is because the difference in export volume is diverted to the other export destination. However exporting to this country is not the focus of this research therefore this section does not describe this segment of export shift.

Table 3.13 Summary assessment of the Sidoarjo shrimp industry

	Benefits	**Barriers**	**Opportunities**	**Threats**
Geographic position	Very fertile land and ponds Near to Surabaya Sea Port and Juanda International Airport	The Porong mud volcano	Pond owners could conduct/organize aquaculture tourism	Vulnerable position near to the active volcanic area Many heavy industries along the Brantas river upstream
The most valuable export products of aquaculture	Contribute significantly to the national income Increase farmer wealth	Export bureaucracy issues Long supply chain	Support other sectors that need shrimp as a raw material	Competition with products from other global shrimp suppliers
Absorb employment	Reducing unemployment rate	Not many young workers who would like to be involved in this sector	Using practical modern technology that doesn't disturb the environmental balance	Other sectors offering more wealth and income
Raw material for other sectors	Supplying related industries with adequate quantity and quality of production	The long supply chain mechanism makes the price more expensive	Increasing demand from food processing companies	Hygiene and packing quality

Sources: Summarised from grey literature that has been used in this chapter and modified by the author

3.5. Conclusion

In a democracy, the country's government is not the sole actor making the rules. Market and entrepreneurs are the example of other actors and they can use the role of the government to their own advantage. Business decisions are enforced by knowledge, resources availability, contractual obligation and government policies (Hirschey, 2009)

As identified in the sustainable livelihoods literature, environmental, economic and political conditions that contribute to economic development can also expose certain sectors and communities to new vulnerabilities. For example, shrimp aquaculture promised prosperity but also caused several problems due to environmental degradation and social disruptions.

Government, shrimp farmers,' and shrimp exporters' relations were quite harmonious due to their mutual interests. On one hand the government needs the high value product of shrimp for supporting regional economy growth; and on the other hand, the shrimp farmer needs government support in increasing their productivity. The harmonious relationship was indicated by routine reports from shrimp farmers and exporters related to the production of their businesses. In addition, in response to the farmer and business reports, the government provided development programs to support the fisheries sector. The support could be seen on the government's annual budget allocation. Another evidence of government support for the development of the shrimp industry sector was the government support for cooperation between the shrimp farmers' associations represented by the Ali Ridlo Group that has cooperated with Alter Trade Japan to develop organic shrimp in Sidoarjo since 1992.

The mud volcano eruption that polluted the Brantas River system, which is crucial for aquaculture within this region, increased shrimp farmers' vulnerability. The mud volcano not only caused the harvest failure or reduced productivity, but also contributed to market concerns about the safety and healthiness of the product.

The next chapter explains the methodology used to investigate the social and economic characteristics that influence the vulnerabilities and resilience of

individuals and local communities who depend on shrimp culture in Sidoarjo, and how they both influenced the response to the mud volcano eruption and were affected by it.

CHAPTER 4. RESEARCH METHODOLOGY

This chapter describes the research methodology used to investigate the key research questions of this thesis. In addition to discussing research methods, this chapter also addresses questions of the research framework. Building on the description of the Sustainable Livelihoods Framework (SLF) in chapter two, it describes how this thesis populates the SLF with data in order to address the research questions.

This chapter consists of six sections. The first section provides a brief description of the research tools used. The second section discusses the applicability of the sustainability livelihood framework. The third section describes technical approaches used for interpreting the data collected from a survey for this project. The fourth section describes the methodological challenges and limitations of the research. The fifth section addresses the ethical considerations of the research and the final section summarises the chapter.

4.1. Research tools used for the data collection

This research employed a literature review, a field survey, key informant interviews and participant observation methods.

4.1.1. Literature review

An initial desk based literature review was conducted from 1 February 2012 to 30 September 2012 in order to develop a theoretical framework, develop an understanding of the broader context of the Porong mud flow, and of the shrimp industry. Further, the literature reviews enable researchers to map the vulnerability of local shrimp farmers to conditions created or influenced by the mud flow. Secondary data and grey literature, including documents, available in either English or Bahasa Indonesian, were also collected from relevant Sidoarjo government agencies and archival resources. This included documents relating to the growth and the production of Sidoarjo shrimp industry and two key strategic plans, all obtained from the Marine and Fisheries Department of Sidoarjo.

The two key strategic plans of the fisheries industry in Sidoarjo are the Marine and Fisheries Strategic Plan 2011-2015, and the Sidoarjo *Minapolitan*[32] Aquaculture Master Plan 2010. Those two documents provide data relating to the Sidoarjo shrimp industry development targets, demographic data, fishing industry targets, shrimp and fisheries production data, economic data, transportation data, and fisheries production statistics. Secondary data specifically referring to environmental and water quality issues associated with the mud volcano in Porong was also collected (Indomaritim Institute, 2011; Tim Pelaksana Kelompok Kerja PPSP Kabupaten Sidoarjo, 2011). Further, budget documents and reports from the Sidoarjo Parliament, and the media and communication reports produced by the BPLS (*Badan Panggulangan Lumpur Sidoarjo*- Sidoarjo Mud Mitigation Agency), through their weekly newsletter *Solusi*, and last but not least, the pollution data from WALHI[33] (*Wahana Lingkungan Hidup Indonesia*-Indonesian Environmental Foundation), an Indonesian environmental concern organization similar to Greenpeace, were obtained (Nusantara, 2009). The information from WALHI assisted in understanding water pollution indicators of the river systems in Porong after the disaster.

The secondary data was classified and catalogued according to the research objectives of the thesis. In particular this process helped to: (i) identify the relevant government mitigation responses and policy directions, constraints, difficulties and also the opportunities encountered by the farmers after the disaster; (ii) map the nature and importance of vulnerability and resilience of local and global market supply chain issues before and after the mud volcano disaster; (iii) identify the degree of pollution and shrimp production changes during the period between January 2006 and March 2013. Additionally, the data sets were used for evaluating the government responses and the formal mitigating efforts of shrimp farmers who were affected by the mud volcano disaster. However, there is a weakness of the secondary data gathered from low level government offices. The data tends to not synchronise with data in the district level. Solving this data weakness, data was

[32] *Minapolitan* is defined as an effort to accelerate the development of marine and fisheries in the fishery production centres.(KKP, 2015a, 2015b).

[33] WALHI is a member of Friends of the Earth International

compared with the interviews and the most reasonable data match with the interviews is used in the analysis.

4.1.2. Survey

A survey was conducted between 3 December 2012 and 15 March 2013. For the purposes of this research, three categories of shrimp worker groups were identified. First is the shrimp farm owner, who has ownership over, or lease rights over ponds. Owners may also take a direct role in managing the shrimp ponds or specific aspects such as raw material supply or marketing of the shrimp harvest. Second is the shrimp pond supervisor, who is an employee of the shrimp pond operation. Supervisors have a high level of experience, and usually have the responsibility to coordinate and supervise other shrimp pond workers. Usually they have been employed by owners who have large shrimp pond operations. The last category is the shrimp pond worker who typically undertakes practical tasks under the supervision of the person who responsible for managing the pond. At several small scale pond operations I identified workers who had long experience in cultivation, and had developed skills equivalent to those of a shrimp pond supervisor. However, because they sometimes work alone and sometimes with the owner of the pond, they were categorised as workers. All workers included in these categories were male.[34]

There were several goals for the survey: First, it identified the condition of the shrimp industry based on the shrimp farm owners', managers', and workers' perspective. Second, it identified and collected data on the dynamic between environmental change including that caused by the Porong mud flow and the adaptation processes adopted by shrimp farmers' in selected subdistricts. Third, the survey filled data gaps left by the secondary data collection.

Following previous work on social research surveys and sampling techniques (Adams, Khan, Raeside, & White, 2007; Saunders, 2016), purposive and proportional sampling was used. In determining a survey sample it is a requirement

[34]The field work did in fact show, there are several female formal-informal workers in the ponds, but the workers who wanted to fill the questionnaire were male workers.

to consider the degree of uniformity (degree of homogeneity) of the population as well as the accuracy of the sample size, (Saunders, 2016) and having proportional gendered presentation.

The proportional survey sample was determined according to certain criteria. The selection process involved several stages. First, the total number (n=5,153) of shrimp farmers operating in Sidoarjo was obtained from de-identified data provided by the Marine and Fisheries Department (*Dinas Kelautan dan Perikanan*) in Sidoarjo. Second, a pilot survey of 30 farmers in 11 villages was conducted that established the proportional ratio of the shrimp farm owners, managers, and workers for each of the selected villages. From this, the main survey sample of a total of 828 participants (16 percent of the total recorded shrimp farmer population) from 16 villages. The sample of 600 respondents consisted of 332 shrimp farm workers, 195 shrimp farm worker supervisors, and 139 shrimp farm owners. Selection of the dependent group was based on participant ownership of, or employment at shrimp ponds proximate to and dependent on water supply from rivers or water ways, known to be exposed to mud flow from the Porong mud volcano. There are at least two rivers and its branches potentially exposed to the mud, Porong River in the south of the centre of the mud and Aloo River in the North of the centre of the mud. A control group sample of 228 participants connected to shrimp farms less dependent on mud-affected water supply was included to validate and compare the results of the data for impact due to the mud volcano.

The dependent group of respondents worked at shrimp ponds located in the ten following villages: Gebang (Sidoarjo Subdistrict), Kedung Peluk (Candi Subdistrict), Banjarpanji, Banjar Asri, Penatar Sewu (Tanggulangin Sub-District), Plumbon (Porong Subdistrict), Permisan, Tambak Kalisogo, Kupang and Kedung Pandan (Jabon Subdistrict). The control group worked in the six following villages: Sekardangan (Sidoarjo Subdistrict), Sawohan (Buduran Subdistrict), Kalanganyar, Tambak Cemandi, Banjar Kemuning (Sedati Subdistrict), and Tambak Sawah (Waru Subdistrict). For the remainder of this thesis the terms, *research target group* and *research control group*, will be used respectively to refer to the above two groups of respondents. The combined research target group and control group will be referred

to as the *total research group*. The geographic locations each group is associated with will be referred to as the *target research location* and the *control research location* (see also glossary).

The survey covered an extensive geographical area which included difficult to reach locations such as mangroves and forests. Data collection was assisted by seven research assistants who were employed as paid contractors. The research assistants were undergraduates of Sunan Ampel University and had completed their research methodology unit. A training workshop held for the research assistants included the conduct of a mock sample interview demonstrating how to administer the questionnaires accurately. The research assistants were also briefed on the importance of adhering to ethics guidelines and upholding the confidentiality of collected data and were required to sign a form of confidentiality.

After completion of the survey, data was transferred onto excel spread sheets then transferred into SPSS data for analysis. The data entry of the questionnaires was carried out from 22 January until 12 February 2013. The details of data analysis tools are in section 4.3.

Figure 4.1 The research location map

4.1.3. Questionnaire design

The survey questionnaire was developed to collect data about the access of the sample groups to the five livelihood assets capitals described in the SLF. The first cluster of questionnaire questions canvassed the basic demographic data of the research participants, including gender, place of residence, personal income and household budget. The second cluster sought to profile the shrimp industry: obtaining data on the structure and value of individual businesses, the material condition of shrimp ponds, including physical size of the property, and the types of equipment used by shrimp farmers. The third cluster was designed to establish shrimp farmer profiles, the size of the workforce employed at respective ponds, and the peer relationship between workers, worker and owner of the shrimp pond. The fourth cluster canvassed the scope of the shrimp culture production market and the method of product delivery including the transport modes. The fifth cluster of questions probed significant changes in the operation of aquaculture. The questionnaire clustering is depicted in Table 4.1.

A different version of the questionnaire was developed for each of the three categories of respondents: namely shrimp farmers, supervisors and workers. The variables were classified based on some common characteristics. For example, demographics of the owner or supervisor or the worker in the shrimp industry; those farmers who adopted intensive, extensive or mixed shrimp production methods, the location of the village near the suspected polluted rivers, and those villages located far from suspected polluted rivers. Ordinal variables and cardinal variables were also employed in this research questionnaire. Ordinal variable subjects were ranked in numerical order from highest to lowest such as monthly income earned by the respondents, or of the shrimp market area that is closest to the farmers and far away from their respective ponds.

The questionnaire was written and administered in *Bahasa Indonesia*. English translation versions of the three versions of the questionnaire are included in *Appendix 4*.

Table 4.1 The six issues covered by the questionnaire

Number	The issue	Data collected
1	Basic demographic data	Gender, place of residence, personal income, and household budget data.
2	Business profile	The condition of the shrimp ponds/embankment, including the physical size of the business property (land area and capacity of ponds), and equipment that had been used by shrimp farmers.
		The structure of the business, including the value of the business, the legal status of the business and the duration of the operations.
3	Worker profile	Number of workers who were employed to operate the shrimp ponds, and the relationship between the workers.
4	The scope of the market	Market coverage and the methods of product delivery.
5	The significant changes in the operation over time	The shrimp production process before and after the recurring mud from the volcano.
6	Changes in livelihood in response to the Porong mud volcano	Record of shrimp farmers' perspectives toward the Porong mud volcano.

4.1.4. Key informant interviews

Data was also obtained from key informants. In conjunction with the administration of the survey, several informal interviews were conducted in the field to explore issues arising from the questionnaire and to assist with interpreting the questionnaire data. After the survey was concluded, approximately 17 semi-structured in-depth interviews were conducted using a snowball sampling technique. The key informants were chosen because of their detailed responses to the survey and also their

demonstrated knowledge of the shrimp industry. Besides the interviewees selected from the survey, officials from government agencies who are responsible for regulating and supporting the shrimp industry were also enlisted. Those interviewed included officials of the Sidoarjo Fisheries and Marine Department, the Sidoarjo Environment Agency, the District Secretary, and members of the local parliament. Finally, business entrepreneurs who were connected with the shrimp industry in Sidoarjo were interviewed. This last sample included shrimp traders or third parties with links to the consumers. Representatives of local organisations that worked with the PT ATINA, and Ali Ridho groups were also interviewed. The semi-structured interviews were carried out from 3 December 2012 to 6 April 2013. The key information and the data collected is summarised in *Appendix 1*.

4.1.5. Semi-structured interview design

Several issues were investigated through the in-depth semi-structured interviews. One issue was the significance of change within the shrimp industry in Sidoarjo over time, especially concerning supply chains, markets, and overall productivity levels. The second focus was on changes caused by the mud volcano. These changes were identified through two variables. The first, degree of impact of the mud volcano to the shrimp industry, and the second, was government responses, disaster relief and disaster management programs covering the strategies adopted to mitigate the negative impact of the mud volcano.

4.1.6. Participant observation

During the data collection phase of the field survey, between 3 December 2012 and 6 April 2013, I also conducted participant observation research for a total of approximately 20 days. This included visiting and staying with shrimp farmers and workers in selected areas and visiting ponds in all 16 sample villages listed in Section 4.4.2. During these visits, it was possible to observe and record the pond management practices used by particular farmers, the frequency and the nature of the technologies used, pond design techniques, and shrimp feeding methods.

Spradley (1980),Cook (2005), and Saunders (2016) divide participant observation into four categories: complete participant, complete observer, observer as a participant, and participant as an observer. As a researcher conducting surveys and at times participating in shrimp farmer activities, my position was that of a participant-observer. On the role of the participant-observer, Spradley (1980) writes that ”beneath the surface, hidden from views, lies a vast reservoir of cultural knowledge”. Experience in the field supported this observation. My language skills in Javanese and Indonesian enabled detailed discussion on issues related to the mud volcano with respondents. It was also possible to join the farmers during their harvesting season. Other occasions involved assisting farmers who were preparing fries for the shrimp ponds. By participating in such activities and establishing rapport with groups of respondents, I received extensive insights into their cultural knowledge, perceptions, beliefs, and their suffering due to loss of livelihoods. The field observations were supported with photographs (see chapters 5, 6 & 7) and a journal of observations, and were used to cross-check and validate the information extracted from the questionnaires.

4.2. Sustainable Livelihood Adaptation

In chapter two, I argued that the issues associated with the research objectives merge and interplay with disaster studies, political ecology, public policy, and human behaviour studies. I also argued the SLF provides research tools and approaches that address this complexity. Furthermore, this framework is able to “utilise a disparate range of methods including standard techniques based upon observation, focus groups, and interviewing”(Morse, 2013, p. 20). Therefore, this methodological approach and associated SLF components were used to organise data about the responses of shrimp farmers to the mud volcano.

The SLF approach consists of five methodological components. The first is mapping vulnerability context and trends. The mapping is a process of collecting and gathering information aimed at identifying one, or several complex influences directly, or indirectly responsible for an individual's vulnerability (influences that are beyond a person’s control). Those complex influences are shocks and stresses that broke down assets directly, a trend that may or may not be a more moderate and

regular shift in prices, employment opportunities and food availability (DFID, 1999; Scoones, 2009).

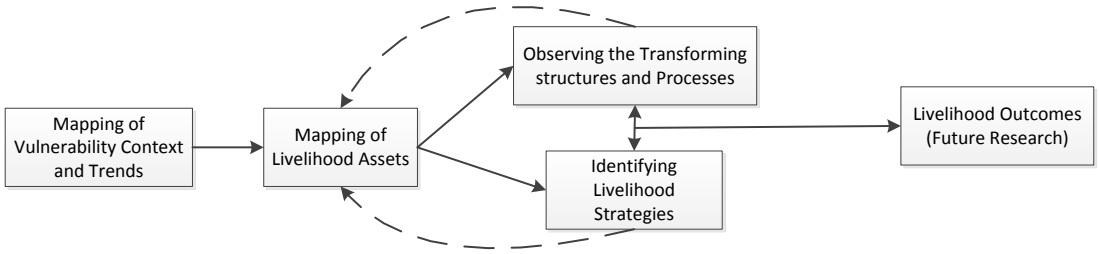
The second component of the SLF covers the mapping of livelihood assets. This mapping is a process in identifying five principal asset categories or types of capital upon which livelihoods are built. As previously stated, the five types of capital are environmental, social, human, financial and physical. This stage investigates the degree of access by communities to their assets, and the terms of exchange between different types of assets (DFID, 1999). In this research, the mapping of vulnerability, trends, and asset related information was obtained through a combination of literature review, the results of questionnaires and from in-depth interviews with targeted key informants. Besides documenting the constraints and opportunities explored by shrimp farmers, the SLF components require data to demonstrate the nature and the impact of the vulnerability/resilience of local and global markets, and supply chain process issues before and during the mud volcano disaster. The combination mapping of vulnerability context and trends, and mapping of livelihood assets aimed to answer research questions that address the general condition of the fisheries sector in Sidoarjo, and the impact of the mud flows on fisheries sector infrastructure.

The third component of the SLF captures transforming structures and processes, the activities that investigate the roles of formal institutions, organisations, policies and legislation that shape and determine the level of community resilience. During this phase, the SLF assists in examining specific roles, responsibilities, and relationships of the stakeholders involved (DFID, 1999; Scoones, 2009, 2015a, 2015b, 2016). This particular SLF component represents the adaptation capacity of shrimp farmers in response to the Porong mud volcano by identifying the outcomes of the alternative livelihoods, and captures the factors and variables that support or handicap the responses of farmers. The combination between the asset transformation process, structural aspects, assets, and livelihood strategies were mapped to answer research question about shrimp farmers' behaviour in response to the mud volcano. In this research, the data required for documenting the information was sourced from archival research data, interviews, and field observations.

The fourth component of the SLF identifies livelihood strategies. Identifying livelihood strategies is a process that designates the range and combination of activities and choices that people make/undertake in order to achieve their livelihood goals. When recording people's strategies adopted in times of crisis, there is a need to pay attention to sequencing, clustering, and the trade-offs of the strategies adapted in response to the shocks and stresses of the *Vulnerability Context* (DFID, 1999; Scoones, 1998). This stage assisted me to record shifts in shrimp farmer practices, which addressed the research question about behavioural responses to the mud volcano. The data for this analysis came from the survey and interviews.

The last component of the SLF identifies the livelihood outcomes that portray the achievements or outputs of *Livelihood Strategies*. The five major elements of the outcomes are (i) having better earning opportunities (ii) increased family and individual well-being, (iii) reducing vulnerability/increasing resilience strategies, (iv) food security (v) sustainable use of environmental resources (Clark & Carney, 2008; DFID, 1999). This component requires a second survey, which could be undertaken to develop this research into a longitudinal study.

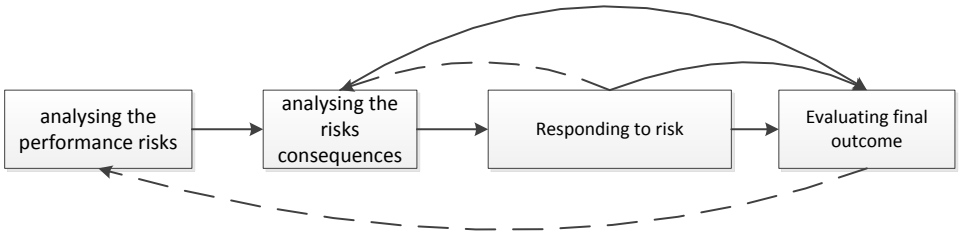
Chart 4.1The five components of the sustainable livelihood framework



In explaining the livelihood strategies, this research also employed supply chain analysis as a tool in explaining the network and distribution of goods and services that occurs in the shrimp farmers' livelihood circles based on contract, social relationship, and social convention. The supply chain analysis contributes to the ability to record livelihood strategies and outcomes through identifying how supply chain relationships are understood as both types of social and human capital enabling different livelihood strategies. The supply chain risk management assessment forecasts and anticipates the possible disruption of a supply chain in the future. By

forecasting and anticipating the potential disruption, the sustainability aspect of livelihood strategies can be developed precisely According to Jüttner et al. (2003) and O. Tang et al. (2012), the utilisation of supply chain risk management has four aspects. As stated in chapter two, these are: (i) identify the sources of risks and consequences; (ii) overcome any possible consequences; (iii) outline the drivers of risks; and (iv) adopt risk mitigation methods. These four aspects of supply chain risk management assist the decision-makers to make the right decisions to protect the business from potential consequences including losses.

Chart 4.2 The four strategic steps in measuring risk performance



Supply chains are both capital assets for shrimp farmers, and a structure that they utilise when putting together livelihood strategies. The capital that influences the supply chain management are: human resources (work force), environmental assets (raw material supply), financial assets influencing the production and sources aspect; social assets influencing the market in strengthening the branding image; and physical assets (infrastructure and technology including the packing) influencing the delivery and returns.

In regards to transforming structures and processes in the SLF, changes in access to those assets also change the supply chain. Transforming a supply chain also opens up new livelihood strategies and the chance of larger returns (livelihood outcomes). Holding particular assets makes a shrimp farmer part of this supply chain. Different farmers have different levels of access and control (which can be considered capital assets), but all of them benefit from the structure. Therefore incorporating a focus on elements that cause changes in the supply chain can be usefully combined with

analysing changes in producers' access to other assets identified in the SLF framework.

Incorporating supply chain risk management and the SLF stages is useful for identifying the transformation process of the shrimp industry in Sidoarjo before and after the mud volcano. Through this research design, I am able to assess broader issues affecting markets and supplies that are linked to shrimp farmers' livelihood outcomes. Chart 4.3 provides the utilisation of the SLF as a research tool representing key components of the SLF linking to the variables associated with the mud volcano in Porong.

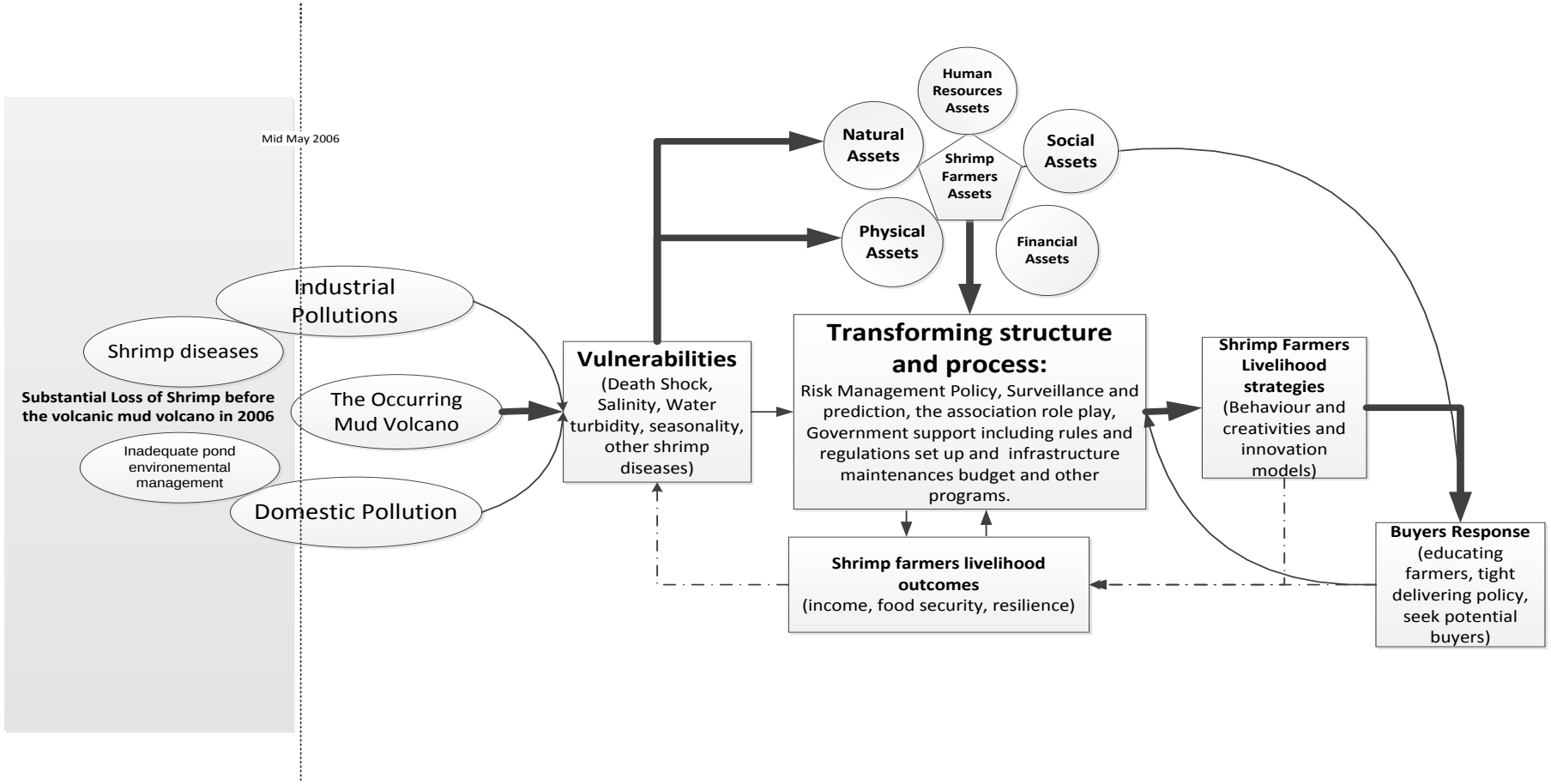
This thesis employs four out of five components of the SLF in order to address the three objectives of the research. The thesis focuses on livelihood choices and outcomes. First, it explores the contextual factors contributing to vulnerabilities among shrimp farmers in response to the mud volcano in Porong. Second, it identifies the patterns of community access to the Livelihood Assets Pentagon. Third, it examines the specific roles, responsibilities, and relationships of the different groups of stakeholders involved. By identifying the roles, responsibilities and relationships, it is able to reconstruct the transforming structures and processes in the shrimp farmers' community. Fourth, it identifies shrimp farmers' livelihood strategies in response to the shock and stress caused by environmental degradation. This thesis does not directly address the full range of livelihood outcomes of shrimp farmers, which would require further research and a longitudinal dataset. However, here the SLF is utilised to examine adaptation to a disaster amongst shrimp farmers through assessing their circumstances, the types of capital they possess, the transforming structures and processes they can utilise, and the livelihood strategies they develop.

Outcomes generally link to the assets; however the outcome has two adverse effects as it links not only to assets but it may also create other vulnerabilities and assets. For example as depicted in Chart 4.3 the outcome of the SLF adaptation scheme is having a positive response from the buyers. It could be considered as another market asset, however due to the acceptance of the buyers, the buyers also create their own standard in expecting a high quality standard of the shrimp. At the same time they

also may seek a potential shrimp supplier which has strict standards in conducting aquaculture and has lower prices, which could make the Sidoarjo shrimp farmer vulnerable.

It was assumed that these features of the SLF, would be useful to analyse both multi-dimensional and multi-faceted issues that are associated with the research objectives and the questions of this thesis. An adapted SLF that is appropriate to capture the issues which affected the local community in Sidoarjo was developed using the five components of the SLF to answer the research question and the objectives of this research project.

Chart 4.3 The SLF adaptation of Sidoarjo shrimp farmer



4.3. Technical approaches used for data analysis

4.3.1. Coding qualitative data

Data collected from interviews was primarily qualitative in nature. The interview data was recorded, transcribed and then manually coded into themes and then organised into separate word files for each theme. The themes were aligned with the questions in the questionnaire. An open coding system was applied to each of the independent (control) and dependent (target) groups to allow the widest range of trends to emerge.

Table 4.2 Component of coding and tasks utilised

Component of Coding	**Task**
1. Open Coding	• Categories and code data broadly • Make notes while reading • Assist in concept mapping
2. Axial Coding	• Use and review initial codes and concepts • Analyse causes and consequences, conditions and interactions, strategies and processes • Categories themes and explore linkages
3. Selective Coding	• Use to select interesting cases of contrasting themes and behaviour patterns

Sources: Neuman (2006); Saunders (2016)

The second step involved reviewing coded data to identify key issues relevant to the research objectives and infer connections among various data elements. The third step highlighted several cases with contrasting themes during the observations as a case study for showing good practices toward disaster resilience in aquaculture. Successive reading and interpretations of the data, including key analytic and explanatory themes, are indicated in Table 4.2

4.3.2. Descriptive statistics and constructing comparable groups

Descriptive statistical analysis was used to represent an overview of the survey data. This analysis describes respondents' answers through the distribution of items of each variable. Adams et al. (2007) assert that the validity of statistical analysis is based on numerical representations of information. The literature highlights numerous statistical methods as useful analytical tools to describe and compare variables that focus on central tendencies and discrepancies of a given phenomenon.

The thesis classifies farmers by geographical location of the shrimp farm, and the extent to which it was impacted by the mud flow, as described in 4.1.2. The thesis also compares the situation for different groups of employees within the shrimp industries of i)the shrimp farm owners, ii) the shrimp pond supervisor, and iii) the shrimp pond worker, as discussed in section 4.1.2.

The questionnaire also captured a range of other types of data that were useful for comparative purposes, and understanding the sector. For example, the information categorised in this study included the respondents' residential address (establishing the distance of their home from the polluted rivers). This classification enabled comparison with the control group that provided an overview of a description of the effects of the disaster based on residential location. Other information includes business ownership, the size of the business (small, medium or large scale operation), who are the affected people; were they employed as a worker or as a supervisor/manager or an owner of a shrimp pond. This information was grouped into six key categories: demographic data, business

profiles, worker profiles, scope of marketing chains, data about changes in the shrimp production over time, and data that demonstrated the changes of the shrimp farming industry and livelihoods due to the mud volcano.

4.3.3. Types of capital in the SLF

The five social capitals adopted from the Sustainable Livelihood Framework are also important for the thesis, and are the basis for chapter 6 on differences between the owners, managers and workers in the shrimp farm industry.

Social capital provides information on: (i) composition of the family; (ii) family income; (iii) the nature of employees and their recruitment process, and (iv) political connectivity. The second capital is financial assets, including all information about the respondents' income, productivity, the degree of accessing credit and other financial support from banks, along with the receipt of money (assistance). The third capital is human assets where the data and information represent the skill levels of shrimp farmers, knowledge, the ability of the respondent, and the leadership structure. The fourth capital addresses physical assets. This cluster includes an irrigation infrastructure, tools and equipment, availability of affordable transportation, security, and access to energy sources. The fifth type, environmental capital, captures data and information about the water and environmental quality, the degree of difficulties in accessing shrimp fry or infant fish, and pond embankment quality.

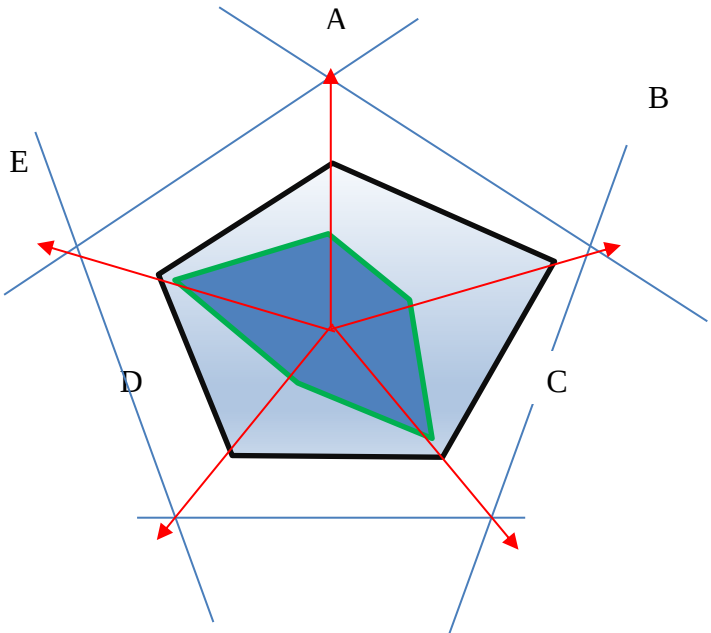
4.3.4. Analysis of the patterns of community access to the Livelihood Pentagon of Assets

According to DFID (1999); Scoones (1998, 2015a) the Asset Pentagon is a central element of the SLF. The Pentagon analysis is used to identify the trade-offs that possibly occurs between different assets. It represents the different distributions of and access to environmental, social, financial, physical, and human resource assets. Further, the Pentagon analysis is able to create a quantifiable indicator of assets in order to seek the sequencing or substitution between assets (Scoones, 1998, 2015a).

For the Asset Pentagon analysis in chapter 6, survey data was analysed using SPSS, and frequencies and descriptive statistics were used to obtain measurements. The results obtained from SPSS were grouped into a scoring table. The information extracted from the questionnaires was grouped into the five types of capital representing the five Pentagon Assets in the SLF, namely human, social, financial, environmental, and physical assets.

The scoring table representing a 0-100 point scale was categorised into three groups. Responses with a score between 0-35 were categorised as low access. The responses with a score between 35-65 were categorised as medium access. Those responses with a score of over 66 were categorised as assets where respondents have good access. After completing the scoring table, the information was uploaded into a Microsoft Excel spreadsheet and converted into charts using a radar model.

Chart 4.4 The Pentagon Asset Model



Legend:

A: Environmental Assets

B: Social Assets

C: Financial Assets

D: Physical Assets

E: Human Resources Assets

Sources: The Pentagon Model adopted from the DFID (1999); Scoones (2009)

Chart 4.4 represents the different distributions of and access to environmental, social, financial, physical, and human resource assets in the target group compared to the control group. The two shaded pentagons in Chart 4.4 demonstrate the condition of the two different research groups. The blue shaded pentagon, represents the targeted research groups whose water sources were affected by mud. The grey shaded pentagon shows the condition of shrimp farmers in the controlled research groups whose ponds/ water resources had not been mud affected. The different shape of each pentagon displays the different levels of access to livelihood assets.

4.4. Methodological challenges and limitations

The focus of this thesis is limited to investigating the events in Sidoarjo from May 2006 when the mud volcano erupted and up to April 2013, the conclusion of field data collection. The research conducted is a case study of shrimp farmers in Sidoarjo impacted by the mud volcano in Porong that makes use of the SLF to assess shrimp farmers' responses to the mud volcano. A case study approach is useful to investigate a chosen research question addressing a single issue. This type of approach can be characterised as a single case study with multiple units of analysis.

During the fieldwork I encountered difficulties in several instances in obtaining important data from the relevant authorities. First, I was unable to access the water quality audit data of Porong and Aloo Rivers, the data is owned by *Balai Pengelolaan Sungai Brantas* (Brantas River Management Centre). Second, although, I managed to interview a key member of PT ATINA personnel, I did not obtain longitudinal shrimp productivity data concerning their shrimp farmers. Third, despite persistent efforts, I was unable to interview officials of the BPLS (*Badan Penanggulangan Lumpur Sidoarjo*-The Mitigation Agency in Porong) due to the sensitive nature of the research topic, but I did locate useful secondary data on their website. The importance of using multi-faceted research methods was demonstrated when I finally obtained data about the government (BPLS) response

to the disaster, unavailable to me from official sources, directly from the affected shrimp farmers.

4.5. Ethics approval for the research

The above research for this thesis conformed to the requirements of Curtin University ethics approval (reference no 124/2012) and as such was conducted following the Australian Code for the Responsible Conduct of Research. Fieldwork, and data collection in Sidoarjo was also conducted using the established research protocols of Indonesia. It also received the appropriate support and clearance from The Islamic University of Sunan Ampel in Surabaya (reference no: is 02/1/TL.00/188/lemlit/P/2012). Before the field work commenced, permission was also obtained from *Badan Keselamatan Bangsa Dan Perlindungan Masyarakat* (Baskebanglinmas) (The National Safety and Public Protection Agency) of Kabupaten Sidoarjo (Sidoarjo District), and subsequently from the head of civil administration in each of the sampled subdistricts chosen as research locations.

The process of recruiting research participants observed appropriate protocols, ensuring that all interviewees signed informed consent forms prior to being interviewed. In order to maintain the confidentiality of the sampled interview and survey, no personally identifiable data were recorded. Participants were informed that they might withdraw at any stage during the interviews without giving any reasons.

4.6. Conclusion

An adapted Sustainable Livelihood Framework (SLF) has served as the organizational framework for data collection and analysis for this thesis. Complex issues have been examined using a mixed methods approach which has included a literature review, field survey, key informant interviews and participant observation. The qualitative and quantitative data obtained by the described methods was analysed using several tools, in particular the Livelihood Pentagon Assets Analysis that depicts the patterns of community access to five livelihood

assets. The supply chain risk management analysis was also utilized within the SLF due to the importance of changes in the supply chain to the assets and livelihoods of shrimp farmers.

The next chapter explores the resilience of Sidoarjo shrimp farmers six years after the Porong Mud Volcano began erupting.

CHAPTER 5. UNDERSTANDING THE RESILIENCE OF SIDOARJO SHRIMP FARMERS FOLLOWING THE PORONG MUD VOLCANO ERUPTION

Several factors influenced the Sidoarjo shrimp farmers' vulnerability. The massive death of shrimp in the mid-1990's, and the mud volcano eruption in Porong in May 2006 in turn created pressure for local shrimp farmers to adapt to environmental changes and seek solutions. Similarly, European Food Safety Regulation 178/2002, the Japanese Ministry Notification No. 370 of the Ministry of Health, Labour and Welfare, "Standards and Criteria for Food and Additives", The USA Bioterrorism and Response Act of 2002, and FAO Regulation on Maximum Residue Limits of Shrimp Products, created further pressures for shrimp producers. With a limited access to assets, shrimp farmers have struggled to adapt their farming practices in order to comply with the demands of both the domestic and global shrimp markets. The background to these events was described in chapter three.

In facing those pressures Sidoarjo shrimp farmers reacted in different ways. This chapter describes the strategic portfolios used by shrimp farmers in Sidoarjo. It pays particular attention to the ways shrimp farmers have responded to and dealt with the pollution hazard resulting from the Porong mud volcano.[35] This chapter argues that because of this historical trajectory of external pressures, Sidoarjo shrimp farmers were able to innovate and create good practices when facing environmental degradation associated with the mud volcano. This chapter examines how shrimp farmers in Sidoarjo were able to mobilise, and in some cases develop, human and environmental capitals to counter the effects of the mud volcano.

[35] Sidoarjo shrimp farmers reacted differently in facing the problems. Most of them still do their business of cultivating shrimp, some of them have left the industry although there was a very small number of farmers who left the industry. The focus of this research is on the majority who have remained therefore the farmers who left the industry were not studied.

The resilience perspective is applied to this chapter as it identifies the adaptive change and learning capacity of Sidoarjo shrimp farmers in facing environmental changes. This chapter identifies four stages of resilience[36] in anticipating the pressures that faced by the Sidoarjo shrimp farmers: i), vigilance and alertness ii) recognition, iii) alteration, and iv) action. This assists with explaining the shrimp farmer resilience process in minimising the negative impact of environment degradation.

The chapter consists of seven sections. First, it describes the response of shrimp farmers to the mud volcano beginning with the effects on the lives and relationships of shrimp farmers. This section also addresses differences in opinions and contradictory analyses found in existing analysis about the impact of the Porong mud volcano. This section records two issues: first it describes shrimp farmers' social relationships after the mud volcano; and second it records shrimp farmers' awareness of environmental phenomena. The second section describes shrimp farmers' perspectives about the degree of importance of the mud to shrimp production levels. The third section reveals the perspective of the research group about the commodity changes of their ponds. The next three sections discuss the adoption of new techniques (human capital), many of which were responses to the mud flow, and also increased ecosystems services to the ponds (environmental capital). The fourth section explores the effort of Sidoarjo shrimp farmers to adopt environmentally friendly cultivation methods. The fifth section discusses the breakthrough technology in shrimp culture called a meandering irrigation method. The sixth section discusses the factors that contribute to shrimp farmers' efforts in exploring their key resources. The final section summarizes the chapter.

[36] The four stages of the resilience process is adopted from the work of Reivich and Shatte (2003) that divided the resilience in four steps: awareness, acceptance, adjustment, and action. Furthermore, B. Walker et al. (2004) see resilience as a capacity in understanding distress and adjusting the changes to make livelihood still have the same function, structure, identity, and feedbacks. Not only that, Cutter et al. (2008) define resilience as a social system to anticipate and adjust the livelihood changes.

5.1. The response of shrimp farmers to the mud volcano

Since the Porong mud volcano first erupted, it has changed the land and waterscapes of an area of 1,500 hectares in Sidoarjo. As well as displacing more than 10,000 people, it has been argued that the mud flows from the volcano have created a serious hazard for aquaculture in Sidoarjo (Gunradi & Suprapto, 2007; Indomaritim Institute, 2011; Samsundari & Perwira, 2011; Sudinno, 2009). This section addresses two issues. First, shrimp farmers' perspectives about the degree of importance of the mud on shrimp production levels and second, it investigates the effects of the mud volcano eruption in Porong on shrimp farmers' social relationships. The data is from field surveys collected in 2013. The results are presented in Table 5.4 and Table 5.1.

5.1.1. The mud volcano and shrimp farmers' relationships with people and environments

In this research, the social relationships of shrimp farmers are addressed through three issues. First is the relationship of shrimp farmers to the other shrimp farmers. Second is the relationship between shrimp farmers and their local community. Third is the response of shrimp farmers to environmental threats. Quarantelli (1997) and Asghar et al. (2008) postulate that explaining the degree of understanding and knowledge of the community members, influences their community awareness about threats to their livelihood. This then makes these three issues important in portraying and observing the creativity of shrimp farmers in seeking solutions.[37]

To investigate the effects of the mud volcano eruption in Porong on shrimp farmers' social relationships, the questionnaire asked the participants: "Do you consider that the mud volcano eruption in Porong has affected your social relationships?" Table 5.1 documents the result. Almost 47 percent of the target group disagreed, with 44 percent disagreeing strongly, that their social

[37] The second issues are discussed in chapter 7.

relationships were affected by the mud volcano. Around 23 percent were neutral and just over 30 percent agreed (22 percent strongly) with the proposition. A higher proportion of the owners, (43 percent) than workers, (32 percent), and supervisors (17 percent) stated that their social relationships had been affected.

Further, Table 5.1 also compared the perspective of the three different occupational groups in the target group and the control group. The control group showed that near to 37 percent disagreed and more than 12 percent strongly disagreed that the mud volcano affected their social relationships[38]. Whereas the research target group who stated that the mud volcano has affected their social relationships almost 16 percent agreed and more that 19 percent strongly disagreed.

More specifically, in the control group, a greater proportion of shrimp farm supervisors and workers that felt their social relationships had changed due to the mud volcano eruption compared to the shrimp farm owners. In general, when the answers are aggregated into three categories: agree, disagree and neutral, the results from the target and control groups are similar. With 47 percent and 48 percent, respectively disagreeing and 30 percent and 35 percent, respectively agreeing that the mud volcano had influenced their social relationships. Furthermore, in explaining the social relationships changes Table 5.2 depicts the perspective of the shrimp farm owners, supervisors and workers about their relationships to the other shrimp farmers.

[38] .First is the relationship of shrimp farmers to the other shrimp farmers. Second is the relationship between shrimp farmers and their local community. Third is the response of shrimp farmers to environmental threats. Fourth is the creativity of shrimp farmers in seeking solutions.

Table 5.1 Change in social relationships of shrimp farmers by survey target and control group

Shrimp farmers' social relationships had changed after the mud volcano.	**Owners**				**Supervisors**				**Workers**				**Total**			
	Target group		***Control group***		**Target group**		***Control group***		**Target group**		***Control group***		**Target group**		***Control group***	
	f	**Percent**	***f***	**Percent**	***f***	**Percent**	***f***	**Percent**	***f***	**Percent**	***f***	**Percent**	***f***	**Percent**	***f***	**Percent**
Strongly Agree	16	18.60	4	8.16	17	12.98	18	29.51	64	27.71	18	18.56	97	21.65	40	19.32
Agree	21	24.42	8	16.33	6	4.58	3	4.92	11	4.76	22	22.68	38	8.48	33	15.94
Neither agree or disagree	4	4.65	5	10.20	44	33.59	20	32.79	55	23.81	8	8.25	103	22.99	33	15.94
Disagree	10	11.63	10	20.41	1	0.76	18	29.51	2	0.87	48	49.48	13	2.90	76	36.71
Strongly Disagree	35	40.70	22	44.90	63	48.09	2	3.28	99	42.86	1	1.03	197	43.97	25	12.08
Total eligible respondents	86	100	49	100	131	100	61	100	231	100	97	100	448	100	207	100

Noted: Target group (mud affected water source); Control group (Non mud affected)

Source: Fieldwork survey questionnaire data, 2013

Over 87 percent of the research group in the target group disagreed, around 81 percent strongly, with a statement that shrimp farmers' networks and daily activities are changing after the mud volcano eruption in Porong. A lower proportion of workers, (6 percent), than owners, (13 percent), or the supervisors, (14 percent), stated that their relationship with the other shrimp farmers had been affected.

The research questionnaire also asked the participants “Has your relationship among the other shrimp farmers changed since the Porong mud volcano?”

Table 5.2 demonstrates three different perspectives of the three different occupational groups in the target group and the control group about the degree of shrimp farmer relationship changes caused by the mud volcano. It demonstrates that while there is a strong disagreement over whether the mud volcano affected relationships, the owner respondents of the research target group were more aware than the control group of changes to their relationships with other shrimp farmers since the mud volcano. The supervisor respondents and worker respondents of the research control group were less aware.

Owners were more aware because, as entrepreneurs, they have to be able to anticipate and predict threats that are able to disturb their business. Financial calculations, cultivation planning, and working arrangements must be planned thoroughly. Whereas the supervisor and the pond worker do not have such planning and calculations as their main considerations.

Table 5.2 The relationship of shrimp farmers among other shrimp farmers

The relationship with the other shrimp farmers has changed	Owners				Supervisors				Workers				Total			
	Target group		*Control group*		Target group		*Control group*		Target group		*Control group*		Target group		*Control group*	
	f	Percent	*f*	Percent	*f*	Percent	*f*	Percent	*F*	Percent	*f*	Percent	*f*	Percent	*f*	Percent
Strongly Agree	2	2.33	0	0	13	9.92	2	3.28	3	1.30	0	0	18	4.02	2	0.97
Agree	9	10.47	1	2.04	5	3.82	0	0.00	11	4.76	0	0	25	5.58	1	0.48
Neither agree or disagree	9	10.47	2	4.08	4	3.05	3	4.92	2	0.87	16	16.49	15	3.35	21	10.14
Disagree	14	16.28	19	38.78	2	1.53	37	60.66	11	4.76	62	63.92	27	6.03	118	57.00
Strongly Disagree	52	60.47	27	55.10	107	81.68	19	31.15	204	88.31	19	19.59	363	81.03	65	31.40
Total eligible respondents	86	100	49	100	131	100	61	100	231	100	97	100	448	100	207	100

Noted: Target group (mud affected water source); Control group (Non mud affected)

Source: Fieldwork survey questionnaire data, 2013

This research also examined shrimp farmers' communication methods. This research questionnaire asked participants "Has your need for communication with the local community changed since the occurring of the Porong mud volcano?"

Table 5.3 provides the response of the research group in the two different geographical locations about the effect of the mud volcano eruption on their communication method[39] with the local community.[40] Similarly to the previous table, the majority of the research group in both target and control locations experienced no change in their communication methods after the mud volcano eruption in 2006.

All in all, the survey indicates that most of the research groups still have effective communications and relations with other shrimp farmers and their communities. According to Granovetter (1985) people who face similar problems tend to communicate more with each other in order to seek better solutions. The shrimp farmers seem to have communicated more effectively because they feel vulnerable and need solutions to threats to their livelihoods.

[39] The shrimp farmer communication methods in this research just acknowledge reciprocal conversations whether direct conversation or conversation using technological instruments such as phones or social media. This information was gathered through the questionnaire with an explanation about the definition of communication method.

[40] Local community in this instance is the community who stay and reside near the pond and their livelihoods are not dependent to the shrimp industry.

Table 5.3 Effects of the mud volcano on communications

Changes in the communicat-ion method	Owners				Supervisors				Workers				Total			
	Target group		*Control group*		Target group		*Control group*		Target group		*Control group*		Target group		*Control group*	
	f	Percent	*f*	Percent	*f*	Percent	*f*	Percent	*f*	Percent	*f*	Percent	*f*	Percent	*f*	Percent
Strongly Agree	6	6.98	0	0.00	11	8.40	0	0.00	8	3.46	0	0.00	25	5.58	0	0.00
Agree	5	5.81	0	0.00	7	5.34	1	1.64	5	2.16	0	0.00	17	3.79	1	0.48
Neither agree or disagree	9	10.47	2	4.08	4	3.05	2	3.28	7	3.03	13	13.40	20	4.46	17	8.21
Disagree	19	22.09	19	38.78	2	1.53	39	63.93	9	3.90	63	64.95	30	6.70	121	58.45
Strongly Disagree	47	54.65	28	57.14	107	81.68	19	31.15	202	87.45	21	21.65	356	79.46	68	32.85
Total eligible respondents	86	100	49	100	131	100	61	100	231	100	97	100	448	100	207	100

Noted: Target group (mud affected water source); Control group (Non mud affected)

Source: Fieldwork survey questionnaire data, 2013

5.1.2. Increasing awareness of environmental phenomena

Understanding shrimp farmers' awareness of their environment cannot be separated from ecological and political economy issues. The longer farmers delay their actions to address environmental changes, the more difficult it is to adapt and the greater the negative consequences of environmental changes (Carpenter, Walker, Anderies, & Abel, 2001).

Based on field observations, there are at least two trends that indicate environmental awareness amongst Sidoarjo shrimp farmers. First, farmers are aware of the importance of mangroves for their pond productivity. Therefore many farmers have planted mangroves around their ponds.[41] This is described in section 5.4.1.

Second, before the mud volcano, farmers would add to or change the water in their shrimp ponds at any time. However, since the event, farmers must consider the Hazardous Mud[42] Disposal Schedule and the Tidal Schedule. Farmers must water their ponds when the Mud Volcano Disaster Mitigation Agency has not scheduled for disposal of muddy water to the river and when the tide is high, so that less contaminated water can enter the pond. This information is gathered from most of the farmers in Jabon and Porong through interviews and participant observation.

5.2. Mud volcano and shrimp production levels

To investigate the perspective of shrimp farmers about the effects of the mud volcano to shrimp production level, the questionnaire asked the participants: "Did the mud volcano eruption in Porong significantly impact production levels?" Table 5.4 documents the result.

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[41] This information also parallels the discussion conducted with the official from the Sidoarjo Marine and Fisheries Offices (Female informant 8) and the representative of PT ATINA (Male informant 14).

[42] As described in chapters one and three, the policy that has been taken by the government is disposal of the hazardous mud into the nearest river.

Table 5.4 shows more than 45 percent of the research group indicated that the mud volcano in Porong was not important in relation to shrimp production levels. More than 45 percent of the shrimp farm owners, more than 59 percent of supervisors and 38 percent of workers stated that the eruption of the mud volcano was not important. 24 percent of the full research group considered that the eruption of the mud volcano was important and had an effect on the productivity of their shrimp pond.

A comparison between the target group and control group indicates that the target group has more awareness of the effect of the mud on productivity compared to the control group, even though the percentage of the target group who stated that the mud volcano is not important is higher compared to the control group.

The findings above show that the impacts of the mud eruption and its management had irregular effects. One shrimp farmer from the control group (male interviewee number 5), revealed that a reduction in Sidoarjo shrimp pond productivity was not only caused by the mud volcano in Porong. Many factors were involved. He stated that: "In my opinion, there was no significant effect on shrimp productivity. This is because the location of the mud is far, and the decrease in shrimp pond productivity is not caused by the mud volcano".[43]

[43] "kalo dibilang seh, belum ada pengaruh significant terhadap produksi udang soalnya memang lokasinya jauh dan penurunan productivitas tambak udang bukan karena lumpur Lapindo"

Table 5.4 Was the effect of the mud volcano on the productivity of the shrimp pond in the target group and control group important?

The effect of the mud volcano on the productivity of the shrimp pond	Owners				Supervisors				Workers				Total			
	Target group		*Control group*		Target group		*Control group*		Target group		*Control group*		Target group		*Control group*	
	f	Percent	*f*	Percent	*f*	Percent	*f*	Percent	*F*	Percent	*f*	Percent	*f*	Percent	*f*	Percent
Important	21	24.71	2	4.17	32	27.12	16	30.19	67	29.26	12	13.04	120	27.78	30	15.54
Less Important	13	15.29	3	6.25	2	1.69	1	1.89	6	2.62	21	22.83	21	4.86	25	12.95
Neither important or not	8	9.41	8	16.67	2	1.69	4	7.55	3	1.31	28	30.43	13	3.01	40	20.73
Nearly not important	5	5.88	13	27.08	0	0.00	13	24.53	34	14.85	28	30.43	39	9.03	54	27.98
Not important	38	44.71	22	45.83	82	69.49	19	35.85	119	51.97	3	3.26	239	55.32	44	22.80
Total eligible respondents	85	100	48	100	118	100	53	100	229	100	92	100	432	100	193	100

Noted: Target group (mud affected water source); Control group (Non mud affected)

Source: Fieldwork survey questionnaire data, 2013

However, in further discussion, male respondent 5 also demonstrated his concern through his statement that "When I observe the river dredging process, I saw that the river mud that had been dredged similarly to the Lapindo mud. This is because the Lapindo mud has been disposed into the Porong rivers".[44] Further, a shrimp farm owner (in a different interview session) stated that shrimp, especially tiger shrimp, tend to live on the bottom of the pond. "Therefore the life of the tiger shrimp that swims in pond water polluted by the poisoned mud will be affected," he stated.

Male respondent number 2 revealed that it took around four years for the mud volcano particles to reach the pond in Buduran. In addition, he claimed that he had identified that some mud in his pond in the Buduran sub district was identical to the particles that were being produced at the mud volcano site in Porong. This claim supports the findings of Sukresno, Priyono, Zahrudin, and Subki (2008) about the spread of the mud in the Madura Strait using Aqua Modis satellite data and numerical data. They show that the sediment distribution in the Porong River estuary is affected by tidal movements, and during the wet season, the flow of sediment in the Porong region is southward with velocity up to 1.0 m/s, while the velocity of current in coastal region is less than that or about 0.4 m/s. This means that particles from the mud volcano spread easily through the Madura Strait, and can enter aquaculture ponds. This finding indicates that there were farmers who first thought they were sufficiently far away from the river ways directly affected by the mud diversion policy and actual eruption, who now fear they may be affected too.

5.3. Commodity Changes

The environment, whether caused by general pollution or the mud volcano, forced the Sidoarjo aquaculture farmers to adapt to change by selecting the most appropriate commodities. Four groups of farmers were found to grow seaweed

[44] "karena kemarin saya melihat waktu ada pengerukkan sungai, disungai yang dialiri tambak itu, lumpur yang ada disungai tambak saya sama dengan lumpur yang ada dilapindo karena lumpur lapindo itu dibuang ke sungai Porong"

instead of cultivating fish or shrimp in Kupang Village. Each group consists of 15-17 members. Based on data collected in 2013, the area of the ponds that grow seaweed reached 601 hectares with a production rate of 10,233.5 tons per year of fresh seaweed. The revenue generated from this production is substantial. On average one hectare must earn between seven and ten million rupiah or equivalent to $AU700- $1000 annually. Second, the time required to grow seaweed is quite short. The farmers could harvest their seaweed after 60-90 days. There are four companies that buy the seaweed production of Kupang village. Those companies are PT. Indo Algae (Wonoayu-Sidoarjo), CV To Sari Jaya (Malang), PT Agarindo (Tangerang), and PT Indoflora Cipta Mandiri (Malang). The demand of those companies on average is 1,700 tons of dry seaweed per month, but the farmers can only fulfil about 200 tons per month (Male informant 5). This change was encouraged by the increase in river pollution.

In another case, since the mud volcano eruption, the policy to divert the water and the mud to Porong River has caused a problem for farmers who cultivate tiger prawns (*Penaeus Monodon).* The particles that originated from the mud volcano are smaller and heavier compared to river mud particles.[45] In addition, this mud also contains oxides, including silica, calcium, sodium and potassium, making it heavy so it easily becomes sediment.

Even though there is a lack of community confidence in the future of the shrimp culture, when the farmers were questioned about the possibility to change their profession from aquaculture to another sector, the majority of the research group did not think that they needed to change their core business to activities outside the aquaculture sector (see

Table 5.5)

[45] The mud that originated from the mud volcano contains 34-53 percent of clay by weight at around 1.25-2.35 cm^3 (Handoko, Rifa'i, Yasufuku, & Ishikura, 2015; Juniawan, Rumjayati, & Ismuyanto, 2013)

Table 5.5 A need to change core business due to the mud volcano

Business change	Frequency	Percent
Strongly Agree	14	2.14
Agree	12	1.83
Neither agree or disagree	82	12.52
Disagree	267	40.76
Strongly Disagree	280	42.75
Total eligible respondents	655	100

Source: Fieldwork survey questionnaire data, 2013

However, when the data is examined separately for each of the three occupational categories, owner, supervisor and worker, as summarised below in Table 5.6, more than 93 percent of target group respondents disagreed, around 80 percent strongly, - they did not want to change their business from aquaculture to another sector.

The data shows that owners are less willing to change their employment compared to supervisors and shrimp workers (around 10 percent difference). Whereas the data in the control group demonstrated the supervisors are the most reluctant to changing their business compared to owners and shrimp pond workers.

Farmers do not want to change their business from the shrimp industry for six reasons. First, they are confident when facing environmental threats due to the knowledge their family holds after working in this sector for more than three generations. They believe the local wisdom and practices in shrimp culture equip their family to cope with the threat (Male respondent 2). Second, Sidoarjo shrimp farmers have been involved in shrimp production improvement programs supported by Japanese buyers represented by Alter Trade Japan since 1992 up to 2012. Within this period, the environmental friendly cultivating process had been introduced; several workshops and human resources upgrading programs had been conducted. Third, there has been government support. Government support has come from the programs of the Sidoarjo government summarised in Table 7.2

and Table 7.2 (cont'd) in chapter 7. This support came via the Sidoarjo Fisheries Academy (Polytechnic of Marine and Fisheries Sidoarjo). This polytechnic is under the Ministry of Marine and Fisheries of Indonesia and supports aquaculture training and development in Sidoarjo.

Fourth, most of the people involved were over school age and they were too old to change their type of work. Fifth, other sectors they could enter would not provide a similar income level to the aquaculture sector. The average income in aquaculture is higher that the regional minimum wage in Sidoarjo. Sixth and last is the geographical location. Most people who work in the aquaculture sector, stay or reside near their workplace. When they are forced to change jobs, this often requires moving far from their residence.

Due to shrimp farmers' resistance to changing employment, they instead seek to adapt to changing environmental conditions. One adaptation is changing cultivation from *Penaeus Monodon* (Tiger Shrimp) to *Penaeus Vannamei* (White leg Shrimp). A successful *Penaeus Vannamei* cultivator in Sidoarjo explained that the characteristic of *Penaeus Vannamei* is quite different compared to *Penaeus Monodon*. *Penaeus Vannamei* can live in most areas of the pond (bottom or floating in the middle and also in the top of the pond), and so avoid contaminated mud and water.

Secondly in terms of disease resistance, *Vannamei* is more resistance to diseases compared to *Penaeus Monodon* (Tiger Prawn).

Table 5.6 The perspective of shrimp farmers by occupation status about having business outside the aquaculture sector

I have changed my business from aquaculture due to the mud volcano.	Owners				Supervisors				Workers				Total			
	Target group		*Control group*		Target group		*Control group*		Target group		*Control group*		Target group		*Control group*	
	f	Percent	*F*	Percent	*F*	Percent	*f*	Percent	*f*	Percent	*F*	Percent	*f*	Percent	*f*	Percent
Strongly Agree	4	4.65	1	2.04	3	2.29	0	0.00	6	2.60	0	0.00	13	2.90	2	0.78
Agree	4	4.65	2	4.08	0	0.00	0	0.00	1	0.43	2	2.06	5	1.12	2	0.78
Neither agree or disagree	2	2.33	0	0.00	1	0.76	2	3.28	7	3.03	11	11.34	10	2.23	37	14.51
Disagree	29	33.72	24	48.98	21	16.03	41	67.21	11	4.76	79	81.44	61	13.62	142	55.69
Strongly Disagree	47	54.65	22	44.90	106	80.92	18	29.51	206	89.18	5	5.15	359	80.13	72	28.24
Total eligible respondents	86	100	49	100	131	100	61	100	231	100	97	100	448	100	255	100

Noted: Target group (mud affected water source); Control group (Non mud affected)

Source: Fieldwork survey questionnaire data, 2013

Another advantage of cultivating *Penaeus Vannamei* is that this shrimp has a short period from seeding period until harvest compared to *Penaeus Monodon*. In addition, the market of *Penaeus Vannamei* is wider compared to the tiger prawn due to the prices. Per kilograms prices, *Penaeus Vannamei* is cheaper and has more diverse markets. *Penaeus Vannamei* cultivation technique is simple and it can be cultivated in extensive models that combine it with other commodities such as *Oreochromis niloticus* (Nile Tilapia - *Ikan Nila*) in one pond. The efficiency of this polyculture technique is in its feeding management. When the farmer feeds the Nile Tilapia, the shrimp also consumes the food. Furthermore, informant 5 also explained that the slime of the Nile Tilapia contains a bacteria that can control pathogens hazardous to *Penaeus Vannamei*. He also claimed that he sent the sample of the Nile Tilapia slime to the Research Center for Brackish Water Aquaculture (*Balai Besar Perikanan Budidaya Air Payau*-BBPBAP) in Jepara to be analysed. This research centre confirmed the theory put forward by informants 5 and 2.[46]

The assumption of informant 5 about the slime of the Nile Tilapia is parallel to the research that is conducted by Zeng et al. (2009) which found that the skin of tilapia is rich in glycine (35.6 percent). The amount of amino acids, proline and hydroxyproline, in acid-solubilised collagen (ASC) extracted from the skin of Nile tilapia is 210 residues per 1000 residues. Which means that the skin (slime) of Nile Tilapia could be used for wound healing medicine.

Last but not least, the advantage of cultivating white leg shrimp (Penaeus Vannamei) is that it can be cultivated in high density.

5.4. Adopting an environmental friendly cultivation method

The survey and field observation revealed five local practices[47] used in the shrimp cultivation industry in Sidoarjo after the massive shrimp mortality in the mid 1990's

[46] The research centre document about the Nile Tilapia slime test result was not shown to the researcher.

[47] A knowledge that developed locally, and or widely used and adapted by locals to apply to localised conditions

and the Porong mud volcano eruption in 2005. These practices, discussed in detail below, are: planting mangroves and polyculture, filtering and use of biological water indicators, water aero insertion processes, feeding techniques, and traditional medication/maintenance of shrimp health techniques.

Each of the five techniques is similar to extensive cultivation techniques. They are environmental friendly traditional techniques. Most of these techniques have been used more frequently due to the increased pollution stemming from the mud volcano. I discuss the increase in frequency for each of the techniques below.

Additionally, extensive cultivation[48] does not use antibiotic, hormonal growth methods or other chemicals that can potentially poison the environment and is similar to organic cultivation methods. Organic cultivation uses ecological principles that when applied do not negatively affect the environment (Tovey, 1997). Thus, organic shrimp farmers use a biological pesticide rather than chemical pesticides, and avoid antibiotics and growth hormones (Hill & MacRae, 1992; Reganold, Elliott, & Unger, 1987; Rigby & Cáceres, 2001; Trewavas, 2001).

Table 5.7 shows the research group's attitude towards adopting new cultivation methods in the target group and the control group, and indicates that they tend to be reluctant to changing their cultivation practices.

Male informant 2 revealed that setting up a water reservoir and installing a filter technique, requires an extra financial cost of around 10-25 percent of a typical pond just for planting of mangroves and the construction of the installation. This statement was also supported by male informant 1 and female informant 9 from the office of Sidoarjo Fisheries and Marine Department.

[48] Most of extensive cultivators in this research stated that they do not use antibiotic, hormonal growth, and other dangerous chemicals, even though in several ponds I found they use pesticide for reducing the pond's weeds.

Table 5.7 The comparison of target group and control group in adopting new cultivation method adoption

New cultivation methods were adopted due to the mud volcano.	Owners				Supervisors				Workers				Total			
	Target group		Control group		Target group		Control group		Target group		Control group		Target group		Control group	
	f	Percent	*f*	Percent	*f*	Percent	*f*	Percent	*f*	Percent	*f*	Percent	*f*	Percent	*f*	Percent
Strongly Agree	9	10.47	0	0.00	11	8.40	0	0.00	3	1.30	4	4.12	23	5.13	5	1.95
Agree	7	8.14	1	2.04	4	3.05	2	3.28	9	3.90	7	7.22	20	4.46	10	3.91
Neither agree or disagree	8	9.30	1	2.04	1	0.76	1	1.64	9	3.90	10	10.31	18	4.02	34	13.28
Disagree	21	24.42	23	46.94	8	6.11	38	62.30	8	3.46	66	68.04	37	8.26	128	50.00
Strongly Disagree	41	47.67	24	48.98	107	81.68	20	32.79	202	87.45	10	10.31	350	78.13	79	30.86
Total eligible respondents	86	100	49	100	131	100	61	100	231	100	97	100	448	100	256	100

Noted: Target group (mud affected water source); Control group (Non mud affected)

Source: Fieldwork survey questionnaire data, 2013

Even though there is a threat from the mud volcano to the shrimp culture, when the farmers were questioned about the changes to their routines and methods, the majority of the research group did not want to change their daily routine for maintenance and development (see Table 5.7). This also demonstrates the importance of the learnings from the massive death of shrimp in the 1990s. Many of the techniques that were used to address the mud volcano were already being practiced, but become more widespread as part of the response to the mud volcano in Sidoarjo. The target group was more reluctant to change their habits and techniques in shrimp culture compared to the control group. This was because when they undertake environmentally friendly shrimp farming, such as practicing silvofishery, the farmer must allow at least a quarter of their pond for planting mangroves, which cost more and reduces the width of the pond available for shrimp culture.

However, participant observation revealed that farmers only considered the costs instead of the benefit of mangrove planting. The Marine and Fisheries Office would need to campaign for the importance of silvofishery in aquaculture to provide a more informed attitude towards mangroves. Providing seeds for mangrove planting programs and educating farmers about the benefit of silvofishery in aquaculture would be the best way to shift attitudes and practices in the long term.

5.4.1. Growing mangroves and applying polyculture

At the peak of the intensive shrimp farming era, producers regarded mangroves as an obstacle to shrimp farming, because of the assumption that the lush green leaves of the mangrove reduced sunlight in the ponds, and the roots obstructed and polluted the water. Therefore, many mangrove forests in the intensive shrimp farming area were destroyed to create more space for larger ponds. As described in chapter three, after a time practicing intensive shrimp culture, the carrying capacity of the pond decreased.

During the period of intensive shrimp cultivation, farmers used formulated feeds and high stocking density, which affected the oxygen supply in the ponds. Therefore, intensive shrimp culture required the installation of aeration tools, such as water turbines, to increase dissolved oxygen.

Learning from the failure as described in Section 3.3.1, farmers tried to avoid the use of industrial and chemical inputs and revert back to traditional methods combined with some innovations. The most important change was an increased awareness amongst farmers of the importance of mangroves. Male informant 2 revealed that farmers had voluntarily participated in planting mangrove since the early 2000s, even though he claimed that he got the knowledge of the importance of mangroves from his father and his grandfather. This was also found in interviews with key informants 3 and 4.

Growing mangroves while cultivating shrimp in the pond generates several positive outcomes for shrimp cultivation. According to male informant 1, mangroves assisted aeration to facilitate oxygen absorption.[49] Second, having shrimp farming embedded within the mangrove forests enhances the value of mangroves. For example, the fruit of mangroves can be used for mangrove syrup or mangrove jam. In Sawohan, based on the information from male informant number 2, the community uses the mangrove wood for badminton shuttlecocks.

In several ponds, farmers planted mangroves not only in the dyke or embankment of ponds, but also allocated many square meters of their ponds for growing mangroves (see Photo 5.1). The aim of planting mangroves is not merely for filtering the water, but has additional benefits such as its use as a medium for cultivating mangrove crab (*Scylla serrata*) and several *fin fish* including *Pangasius pangasius, Lates calcarifer* and *Oreochromis notices* (Tilapia).

[49] Detailed explanation of the natural aeration by the mangroves is explained at subchapter 5.4.2

Photo 5.1 Mangroves in a pond

Credit Photo: Iwan Hamzah

Aquaculture that is combined with mangrove forest is recognised as silvofishery. The benefit of applying the silvofishery concept in shrimp culture has been revealed through participant observation. The benefit of silvofishery, besides being able to enhance the productivity of the ponds, is to also improve the economic potential of the wider community through ecotourism activity and local small business enterprises engaged in processing products such as the mangrove fruit used for jams or other products originating from the mangroves. My field observations and interviews indicated an increase in silvofishery as part of the response to the mud volcano.

5.4.2. Biofilter and biological water indicator

As described and discussed in section 1.2, the disposal of river mud has polluted the river water supply to the shrimp ponds. As a result, the aquaculture community of Sidoarjo has become more aware of the importance of the quality of the river water used for their ponds.

Based on participant observation of the daily activities of the aquaculture farmers in managing their ponds and lands during field work between December 2012 and April 2013, the research recorded a good practice of shrimp farmers in filtering river water. The farmers who were practicing filtering river water were identified as previously being partners of the PT ATINA. This is significant for two reasons: first the degree of success in filtering river water also contributes to providing better water for the

shrimp, and second the role of PT ATINA in providing technical assistance also contributes to the farmers' skill in conducting better aquaculture technique.

5.4.2.1 Biowater filter

Biowater filtration means the use of living vegetation to filter river water. There are at least three species used for filtering the water. The first is *Rhizophora spp*, which is commonly known as the real mangrove. This type of mangrove has very long roots that penetrate through the mud and elevate the plant above the water. Farmers usually plant this mangrove along the canal that connects the river with the ponds' water provision (Photo 5.2). The submerged roots absorb pollutants contained in the river water. Several farmers in the control group indicated in informal interviews that they used this type of mangrove as a bio filter of river water. Farmers use the *Rhizophora spp* for two types of filter methods, the straight and the meandering. These methods will be discussed in subsection 5.5.

The second species is the *Salvinia Molesta*; the farmers plant the vegetation in the canal and the water provision area as a water filter. Then the filtered water is distributed to the cultivation pond and discarded water (after use in cultivation pond) goes to the treatment ponds. The *Salvinia Molesta* has the ability to absorb pollutants such as heavy metals from the river water. On the other hand, there is a disadvantage of using *Salvinia Molesta* in aquaculture in that it grows rapidly and is able to reach up to 400 tonnes of wet weight per hectare, and can invade the ponds. As a result, many farmers consider it to be a weed in the wetland.

Photo 5.2 The Irrigation Canal heading to Shrimp Ponds in Sekardangan

Credit Photo: Author, 2013

The third vegetation used is *Eichhornia Crassipes*. *Eichhornia Crassipes* is known as water hyacinth or *enceng gondok* (Bahasa). *Eichhornia Crassipes* has the ability to absorb approximately 60-80 percent of nitrogen (Fox, Struik, Appleton, & Rule, 2008) and eliminate approximately 69 percent of potassium from polluted water (Zhou et al., 2007). *Eichhornia Crassipes* is used as a biological filter for absorbing heavy metals.

Furthermore, *Eichhornia Crassipes* has other potential commercial benefits as raw material to feed live stock such as cattle, goats, sheep, ducks, and tilapia. It is also used for the production of fibreboard, materials for paper production and, most importantly, water purification (A. Bhattacharya & Kumar, 2010). Interestingly water hyacinth has the potential to be used as a component in producing biogas (A. Bhattacharya & Kumar, 2010; Gutierrez, Ruiz, Uribe, & Martinez, 2001; Lindsey & Hirt, 1999).

Similar to the *Salvinia Molesta*, *Eichhornia Crassipes* has several disadvantages. This water plant has the ability to grow fast (Jafari, 2010; Parolin, Rudolph, Bartel, Bresch, & Poncet, 2010; Song & Kim, 2013) which causes water blockage due to the density of this plant. In addition, dense concentrations of water hyacinth can hinder the oxygen supply for fish and shrimp. This was present in most of Sidoarjo before the mud volcano.

5.4.2.2 Biological water indicators

Besides using living vegetation, farmers also use aquatic animals such as Green Mussel (*Perna Viridis)*, Mangrove Snail (*Telescopium Telescopium L*), and *Scylla Serrata* or Mangrove Crab. These animals are used for filtering or absorbing hazardous material from the water and as a biological indicator of water pollution. For example, green mussels suck the water for their digestion process. While the green mussels digest, they filter the water. Mussels can filter various contaminants such as heavy metals from pond water.

Mangrove snail or *Telescopium Telescopium L* has a similar digestion process to green mussel or *perna viridis*. The shell and soft tissues of *Telescopium* can be considered as a potential indicator of copper, zinc, and lead (Yap et al., 2009). The shrimp ponds that are equipped with a bio filter system in their water management can increase shrimp survival by up to 25 percent, compared with ponds that do not use a bio filter (Brata Pantjara, Erfan Andi Hendrajat, & Suwoyo, 2010). According to informant 2, this method can be applied in small and large scale shrimp farming.

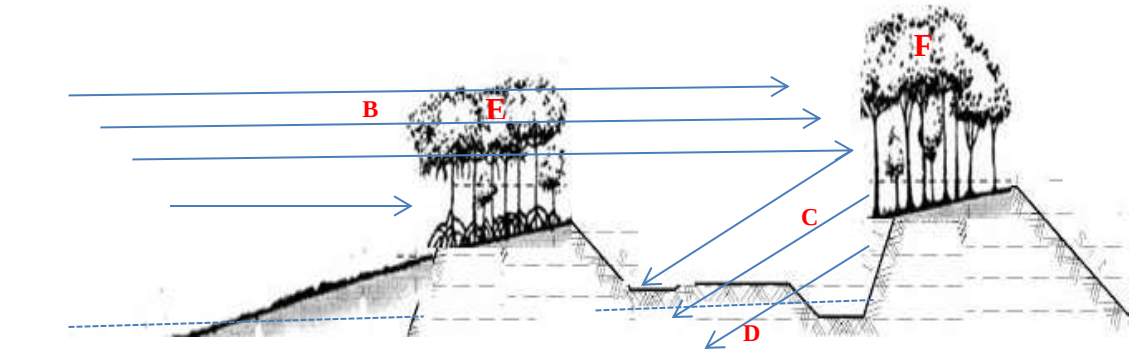
In an interview, male informant 2 revealed that Sidoarjo shrimp farmers have also used mangrove crab or *Scylla Serrata* as a biological indicator since 2000. They put crabs in a cage by the water gate, which connects the water reservoir pond with the canal or ditch that flows to the cultivation ponds (see Figure 5.3). The farmers are then able to monitor the water quality through the condition or the health of the crabs.

Since suspecting that the mud particles of their pond are similar to the particles of the Porong mud volcano, this method has become widespread since the mud volvano. The informants explained that the morphology of the species makes it particularly sensitive to the pollutant. Crabs tend to be unusually active or behave abnormally, when the water contains hazardous substances. In the worst situation, when the filter system fails, crabs die. Farmers respond by closing the water gates to isolate the cultivation ponds from suspected pollutants.

5.4.3. Water aero insertion technique

The health of the pond is closely connected to the quality of the water source. One of the indicators of healthy water is the sufficiency of oxygen. Traditionally, there are two techniques of inserting oxygen to the ponds. The first method involves another use of mangrove plants, *Avicenna marina* or *Azadirachta indicia Juss*. In an in-depth interview, the secretary of FKMT and the chair of the Karya Makmur Shrimp Association of the Kedungpeluk village of Candi Subdistrict, revealed the process of redirecting the wind that blows from the ocean to the water pond. The mangrove fortress also redirects the sea wind that blows in the night to enter the water. The process of this wind can be seen in Figure 5.1.

Figure 5.1 The wind redirected process



Sources: Fieldwork observation and interview, 2013

Legend: A – Ocean/Sea; B – Ocean/ sea wind; C – Redirected wind ; D – The Cultivating Pond; E – Mangrove in coastal area; F – Mangrove in pond ditch

The second aero insertion technique is through a polyculture cultivation method. Implementing a polyculture that cultivates tiger prawns (*Penaeus Monodon*) with *Chanos Chanos,* helps the aero insertion process. The logic in increasing the oxygen supply in the pond is based on the morphology and habits of the *Chanos Chanos* that are often seen on the surface as their interaction creates a splash of water. The splashing water activities are believed to be a water aero insertion technique.

5.4.4. Feeding techniques

One aspect of a sustainable aquaculture system is the security of feeding material supply (Fatchiya, 2015). In several informal discussions during the survey, three traditional techniques in shrimp feeding were revealed. These were the *klekap* method; the *Lumut* method, and growing plankton. While not directly related to the mud volcano, these techniques are a form of human capital that has become widespread in Sidoarjo.

In the semi-intensive ponds, farmers add artificial feed to increase farm production. At this level, the feed provided is supplementary. Typically, this feed stuff comprises materials easily obtained around the pond at a cheap price. To grow natural food in the pond, farmers observe what kind of natural foods is being eaten by fish or shrimp or shrimp fry spawning in their plots. Examples of suitable natural food are *klekap* and plankton that could be used separately or as a mixture together.

4.4.5.1 **Klekap method**

The *klekap* method was explained by male respondent 6 and male respondent 7 who represent farmers working with PT ATINA in cultivating eco shrimp in Buduran sub district and by male informant 2, one of the role models for tiger shrimp cultivation in Sidoarjo.

Klekap is an algae that consists of *Oscillatoria, Phormidium, Lyngbya, Spirulina,* Diatomae (*Navicula, Nitzschia, Amphora, Pleurosigma*), Protozoa (*Zoothamnium, Vorticella, Epistylis, Acineta*), bacteria, *Rotifera* and worms. *Klekap* is able to grow on the walls and bottoms of the ponds. The algae that grow have chlorophyll that enables the process of photosynthesis.

According to male respondents 6, 7, and 2, the process of making *Klekap* takes from 7 to 15 days. While waiting for the *Klekap* to grow in the bottom of the pond and then become compacted, the farmer also makes improvements in the infrastructure of the ponds. These improvements include strengthening pond embankments, and cleaning and repairing the irrigation channel that is located inside the pond. Some farmers call this *caren*.

The water gate and drainage maintenance process are conducted by clearing the ponds of mangrove roots that spread inside the ponds. After finishing the drying and compacting process, the next step is to add organic fertilizer. The quantities of organic fertilizer needed depends on the soil fertility level. According to male respondent 2, the organic fertilizer composition consists of chaff, ground coconut, cattle manure (cow, buffalo or goat) or guano (bat manure).

After fertilizing, the next process is a wetting process. The wetting process is started by filling with seawater to a height of 3-10 cm. The seawater enters, then evaporates under the sun until around 20 percent dry. This process aims to neutralize organic materials in the fertilizer.

After the drying process, the next stage is adding urea[50] and TSP[51]. Before adding the urea and TSP, the pond is watered to a height of 10-15 cm for 50 kg per hectare per pond. However, for ponds that contain a lot of mud the ratio of urea and TSP is 2:1. After this stage, farmers fill the pond with sea water up to the adequate level for fish and shrimp. The last stage is preparing the shrimp fries and the fish seed to be cultivated in the pond.

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[50] Urea is a chemical fertilizer containing high levels of Nitrogen (N). Nitrogen is an essential nutrient for plants. Urea is an organic compound composed of elements of carbon, hydrogen, oxygen and nitrogen by the formula CON2H4 or (NH2) 2CO. Urea is also known by the name carbamide or diaminomethanal.

[51] TSP is Triple Super Phosphate Fertilizer. This fertilizer (TSP) is an inorganic nutrient used to improve soil nutrients for agriculture. TSP chemical formula is Ca(H2PO4). This fertilizer contains P2O5 (Phosphate) about 44-46%.

4.4.5.2 *Lumut* method

Lumut method is a method of growing mould for shrimp feed. Most key respondents mentioned this method when discussing traditional shrimp feeding. It involves trough grown fungus used as a natural feed for shrimps.

The first step in the preparation of this method is drying moss from the bottom of the pond, which takes about three days in the sun. Male respondent 6 explained that the use of the sun shining on the bottom of the pond is to create a humid environment for growing moss. Subsequently, dried soil is planted with green moss evenly over the surface (yard plot), and water is added to approximately 20 cm deep.

After 3-7 days of watering the pond, the next step is adding fertilizer such as urea and TSP. The urea is used at 48 grams per cubic meter of water and TSP at 20 grams per cubic meter of water. A week after the last treatment, the pond is watered up to 40 cm height. In this state the moss grows and is ready to be the food supply of the shrimp.

4.4.5.3 Growing plankton

The plankton growing method was explained by male respondent 2 while the researcher followed him in his activities in maintaining his pond. Growing plankton is quite different from the previous two methods. In the earlier explanation of growing plankton, male respondent 2 stated that precise measurement both in watering and fertilizer composition is a significant factor. He argued that plankton requires adequate water and an accurate combination of nitrogen (N) and phosphorus (P).

In detail he explained the four steps of growing plankton. First is a drying process, which takes from 3-5 days. Second is watering up to a height of 70-100 cm. The water can be sea water or water from a reservoir pond. Third is adding fertilizer (urea and TSP), per cubic meter of water, ideally is needed 2,065 gram urea, and 1,097 grams TSP. Both fertilizers are mixed evenly, then placed on a table which is specially designed, and submerged 15 -20 cm below the surface of the water. This table is made of bamboo poles with a plate or board. The size of the table is 0.85 x

0.85m for one hectare. The table is mounted on the edge of the pond following the wind direction. Fertilizers dissolve slowly and spread over the pond through water movement.

The last step is evaluating the density of the plankton through use of a water clarity test. Water that has more phytoplankton is greener than the water with less phytoplankton. This test uses a *Secchi* disk. Put the *Secchi* disk at 30 cm depth, once the *Secchi* disk is not visible this means the density of the phytoplankton is high and needs to be reduced by removing some of the water and adding new water. However, if the *Secchi* disk is visible and the water volume remains stable, it means that the ponds need more fertilizer.

5.4.5. Traditional medicine techniques

Besides preparing the food stock for the shrimp, shrimp farmers have also developed their own traditional medicine[52] techniques. This research defines traditional medicine as a kind of potion produced from plant based and other natural ingredients. Farmers retain and develop the formulas from knowledge passed on to them from their ancestors. This research recorded four traditional medicines used for maintenance of the ponds. These are *Samponen* (Tea seed powder), *Sirih* (*Ipiper bettle L*), Mimba (*azadirachta indica Juss*) and probiotics.

5.4.5.1 **The use of *Samponen***

Most shrimp farmers interviewed and surveyed mentioned *Samponen* for their pond maintenance and medicines. *Samponen* is used for generating local microorganism for growing plankton. *Samponen* or tea seed powder contains dried seeds of *Camellia sp*. from which the *Camellia sp* is extracted. The use of *Samponen* is to eliminate not only various wild fishes and shrimps but also spawn of frogs, tadpoles, earthworms, leech, and nematodes from the pond. The *Samponen* is safe for the pond vegetation

[52] Referring to WHO definition, traditional medicine is defined as the sum total of the knowledge, skill, and practices based on the theories, beliefs, and experiences indigenous to different cultures, whether explicable or not, used in the maintenance of health as well as in the prevention, diagnosis, improvement or treatment of physical and mental illness.

such as plankton or algae. This tea seed powder is able to make the shrimp exuviate (shed their shells) faster than normal and the shrimp grow faster. It also assists the decomposition of organic fertiliser and enables the accelerated growth of the algae.

Since the protein content of tea seed is high, it has increased the efficiencies of fertilizer used (explained by several farmers on several discussions in field observation). For ponds where silt is rare and basement soil is barren, tea seed increases the worth of the fertilising process without generating any pollution.

5.4.5.2 **The use of *Sirih* (betel)[53]**

Sirih (betel)[54] is used for treating various kinds of shrimp diseases. This practice has been used for a long time in Sidoarjo aquaculture. The male informant 6 explains the use of *Sirih* in aquaculture. S*irih* has essential phenol oils and etheric oil used as a strong natural antiseptic (Praba, Jeyasundari, & Jacob, 2014) and antioxidant (Abrahim, Kanthimathi, & Abdul-Aziz, 2012). Beside phenol, this leaf has other anti-inflammatory and anti-bactericidal chemical components called *Saponins* and flavonoids. The problem faced by the farmers in using this method is that they do not have a precise measurement for adequate amounts of *Sirih* to treat the shrimp.

5.4.5.3 **The use of *Mimba* (*Azadirachta indica juss*)**

Mimba or *Azadirachta indica Juss* is used as an antibiotic substitute that aims to eliminate the bacteria that endanger shrimp. The use of *Mimba* leaves, reduces the potential of having antibiotic residues in shrimp production. Another effect of this leaf is that it can improve shrimp appetite.

Male respondent 6 and 2 explained how to use *Mimba* leaves. First of all the *Mimba* leaves are boiled in water, and then mixed with shrimp feed and dried. After the mixed shrimp feed and *Mimba* dries, then it is sown in ponds. The use of *Mimba*

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[53] The first time I heard the story of the use of *Sirih* was when I had discussed with one of aquaculture practitioners in Jabon when I was participating in a Boy Scout camp in Trocor in the mid-1980's. Trocor is a village in Jabon Sub district in Sidoarjo

[54] Piper betel is the leaf of a vine belonging to the *Piperaceae* family

leaves on shrimp culture parallels its use as human medication as a cure for several diseases such as some skin diseases and as an anti-inflammatory for fever. Moreover, it's also commonly used for antibacterial purposes, as an antidiabetic and other medical uses such as for the treatment of cardiovascular conditions.

5.4.5.4 **The use of probiotics**

In several pond visits for informal observation, it has been found that many of the farmers use probiotics in their ponds. Probiotics[55] are good bacteria that help fish or shrimp remain healthy. Probiotics for fish and shrimp are available on the market and contain several types of bacteria such as *Nitrosococcus* and *Nitrosomonas* bacteria which function to increase the quality of land soil as they act as fertilizers through the transformation of nitrite to nitrate (nitrification) (Foesel et al., 2007).

Other bacteria in probiotics include *Methanobacterium* which has a function in the decaying process of fish debris and dirt (Jetanachai, 1987; Zhang et al., 2016); *Rhizobium* that functions as a nitrogen binder that increases the fertility of water ponds (Atmomarsono, Muliani, & Nurbaya, 2009); and *Lactobacillus Bulgaricus*, which functions to produce lactic acid, which helps decompose lactose (Gore et al., 2012).

Based on in-depth interviews with several pond owners, the advantages of using probiotics include increasing the feed efficiency, adding a nutrient feed, stimulating the fish's appetite, and increasing fish and shrimp endurance against diseases (Male informants 2, 3, 6 and 7).

Next, the most important function of probiotics is to reduce the dominance of pathogenic bacteria (*Vibrio sp*) and address the pollution caused by the excessive accumulation of organic material in the bottom of the pond that degrades water quality (Alie Poernomo, 2004b). According to male informant 14 (a representative of

[55] In this research probiotics are categorised as traditional medicines due to the manufacturing process of the probiotics uses traditional ingredients and uses very simple instruments.

PT ATINA), the use of probiotics that contain hormones and other substances has to be avoided. This is due to the import restrictions of the European Union and Japanese markets that forbid the importation of agricultural products grown in or with this form of probiotics.

Male informant 14 and male informant 2 revealed that by having the assistance and guidance from PT ATINA in making and producing probiotics, the farmers are able to produce probiotics that consist of safe materials, easily found in their surrounding area.

Male informant 2 provided further explanation on how to make traditional probiotics from natural sources. He uses ginger, *Kencur-Kaempferia*, galanga, turmeric, tamarind, molasses, red ginger, red betel, moss, coconut water, pineapple, and fresh milk as raw materials to make natural probiotics. The bacteria are developed from Yakult, a probiotic drink sold in the market, or from cow's rumen, which is a food stuff in a cow's intestine that farmers obtain from the slaughterhouse nearby. Those ingredients are mixed and compounded into a probiotic that is safe and not harmful for both for the shrimp and the consumers.

5.5. Meandering irrigation method

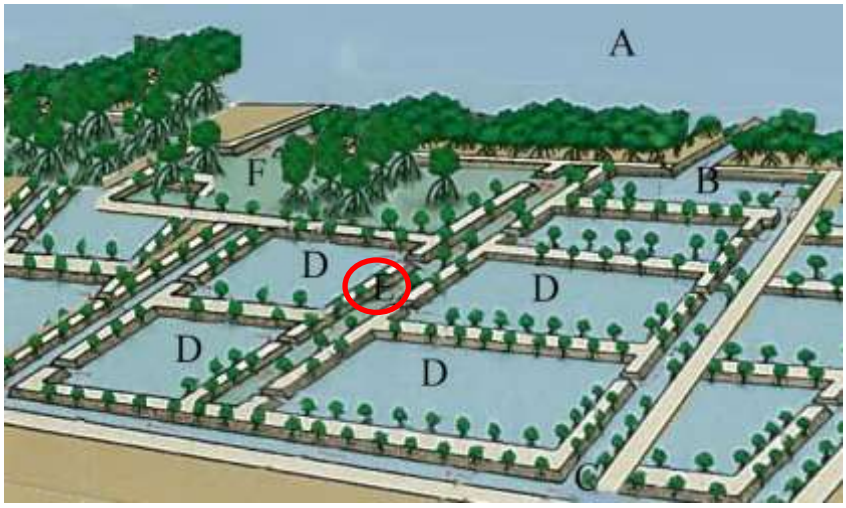
The group of farmers who invented the meandering system[56] started their experiment when they found that sludge material in their ponds is similar to the sludge in the river near the mud volcano. Farmers were also responding to decreasing river fish and shrimp catches. This technique was developed in response to the mud volcano.

The farmers conducted experiments in their ponds. Key informant number 2, a representative of a shrimp farmers group who practices the meandering system,

[56] Instead of those four reactions: i) increase the awareness to environmental phenomena, ii) commodity changes, iii) adopting an environmental friendly cultivation method, and iv) practicing meandering irrigation systems, farmers also sold their ponds and changed their business to another sector. The number of farmers who sold and changed their businesses was not large and much of their reasons were because they had to sell due to the ponds being their parental inheritance, and they had to share it with their siblings, or the area where the ponds were located had changed from an agricultural area to become a residential or industrial area. As this was not related to the mud volcano, this finding is not described in the paragraph.

explained that in the beginning, he allocated one part of his pond that is located near the water gate that connects to the river for growing mangroves. This experiment process is depicted in the Figure 5.2

Figure 5.2 the shrimp pond model 1



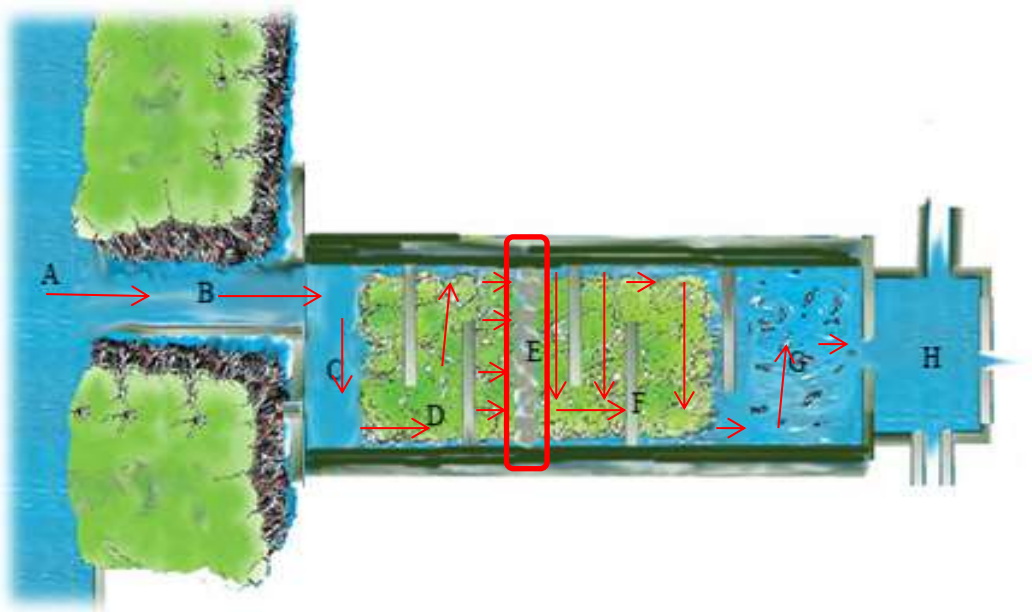
Sources: Field Observation, 2013

Legend: A – River; B – The mouth of pond Canal/Water Provision; C – Pond Irrigation; D – The Cultivating pond; E – Waste irrigation (red circle); F – Waste treatment

As shown in the Figure 5.2 the water river (A) is channeled to the pond through the water provision (B) and is distributed along the pond irrigation channel (C) to the ponds (D). After that, the water that is used flows into the exhaust channel (E) to the waste treatment pond (F).

In response to worsening water quality, the male respondent 2 evaluated the process of filtering the river water using a straight filtering method depicted in Figure 6.2. The male respondent 2 and his group modified their endowment pond (water provision pond-area B) from just a square form to become an elongated form and engineered the water stream longer in a meandering model to make the water flow slowly. The slow stream of water quickened the sedimentation process of the water. The meandering system is depicted in the Figure 5.3.

Figure 5.3 Meandering pond model



Sources: Field Observation, 2013

Legend: A – River; B – the mouth of pond Canal; C – Water Provision Pond Irrigation; D – *Avicennia Marina* (*mangrove api api*); E – charcoal; F – coral and limestone G – endowment pond; H – water gate systems that distribute the water to the ponds.; I; – *Rhizophora spp (Mangrove Tinjang)*

In order to maximize the process of sedimentation, this group of farmers are also planting the mangrove *Rhizophora spp* in area D. In addition, they put coral and charcoal for filtration at point E. (see Photo 5.3)

Photo 5.3 Coral and charcoal pond water filter

Credit Photo: Iwan Hamzah

At the final stage of the meandering system, on the edge of the irrigation area (location G), farmers put fish such as tilapia, *Pangasius pangasius* and *Lates calcarifer* that can adapt to harsh or polluted environments. According to male informant 2, these kinds of fish provide two advantages. First the fish can be used as a biological indicator when the water filter fails to filter the hazardous material from river water. Second, the fish also become an additional usable product. When crabs are used as a biological indicator (see section 0,), the crabs are placed in the water gate located between location G and Location H.

5.6. Discussion

The knowledge and past experience of the farmers in dealing with production problems has enhanced their capacity to face threats. Human capital and physical capital, in particular technology, are the main variables that influence human reactions. The introduction and background chapters showed that the mud volcano eruption affected the aquaculture in Sidoarjo. As known as a whole, vulnerability is a dynamic processes. For example, the mud volcano in Porong caused most irrigation systems within the vicinity to become polluted and have decreased aquaculture production (see section 1.2). Despite that loss and destruction, resilience processes also occur.

According to Drucker (1992), Huppert and Sparks (2006), and Howkins (2011), knowledge and skills are the factors that influence the farmers' behaviour. Farmers' awareness of the risks and challenges depends on the capital assets they possess especially their knowledge and skills. The more educated the farmer (human capital), the more aware he is of threats and risks.

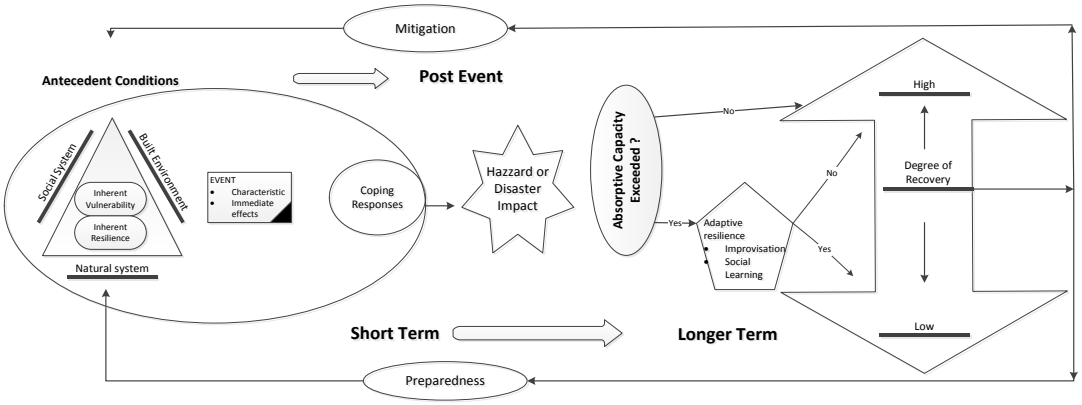
Success in controlling and managing risks and threats is understood in this thesis through how farmers make use of their array of capital assets to either shift or maintain their livelihood strategies. Inevitably, through these processes, disasters confront and transform consciousness, shape individual actions, and lead to a strengthening or dissolution of institutional power arrangements. Therefore, environmental catastrophes tend to generate physical and social tensions among people who are directly and/or indirectly affected by such events.

Those resilience activities were identified from the farmers' ability to adapt to declining environmental health, and to diversify their products. The diversification of processes and products can be seen from the changes in shrimp production from intensive methods to traditional methods, practicing polyculture, and applying the silvofishery. In short, the shrimp farmers' reactions in facing a severe environment situation are influenced by the degree of their ownership to assets.

The farmers' efforts both in changing their end product and cultivation methods are responses to the need to ensure profitable production (Cousins et al., 2004; Hendricks & Singhal, 2005). The changing behaviour of the farmers through utilising their networks (social capital) are part of the transformation process, and the resilience of the farmers toward the environmental hazards, in this case a decline in river water quality (environmental capital). The transformation and resilience process of the shrimp farmers were an effort to protect the capital they possessed and therefore continue their current livelihood strategies. Understanding the importance of transforming structure and process in the SLF (section 4.2) involves a critical analysis of the specific roles, responsibilities, and relationships of the stakeholders involved.

Applying the Place Base Model developed by Cutter et al. (2008), the resilience position of the Sidoarjo shrimp farmer can be seen as a two part process, before the event and after the event.

Chart 5.1 Mitigation and preparedness process to disaster



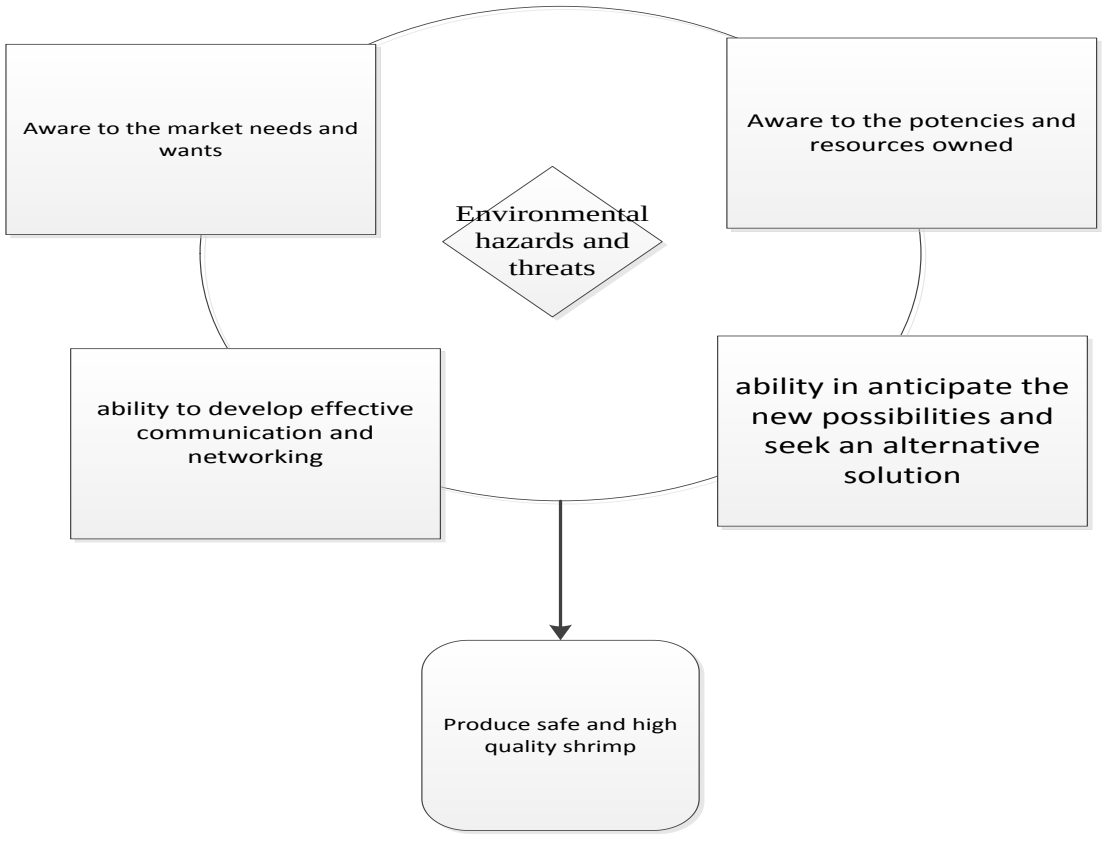
Sources: (Cutter et al., 2008)

During the antecedent condition, farmers could add to or change the water in their shrimp ponds on a needs basis. However, since the occurrences of the mud volcano, the shrimp farmers' have needed to consider the hazardous volcanic mud when they need to water the shrimp ponds. The farmers' need to understand both the mud disposal schedule operated by the BPLS (*Badan Penanggulangan Lumpur Sidoarjo*-Mud Volcano Disaster Mitigation Agency), and the tidal schedule. The farmers' action of changing their watering times, considering the schedule of the disposal of muddy water in the river, and the role of the tide, is categorised as an adaptive resilience. In this way the chances of contaminated water entering ponds were reduced.

The adaptive resilience that has been shown supports the arguments made by Klein (2007) and O. Tang and Musa (2011) that prolonged socio-ecological stress forces people to seek solutions or help to minimise risks. Moreover, the preceding section also demonstrates the shrimp farmers' innovation in managing their pond irrigation. The Meandering Irrigation Method was claimed to have been developed after the mud volcano. At this stage the shrimp farmers' ability in improving their technique and skill in filtering river water through the Meandering Irrigation Method demonstrates the shrimp farmers' preparedness in dealing with hazard or mud volcano impacts.

According to Larry and Reham Aly (2004), once the problems have been recognised and the factors and influences understood, actions are needed. Field observations and interviews with supervisors indicated quite successful use of adaptation strategies in order to avoid changing livelihood strategies. The harsh environmental conditions that threatened the aquaculture area challenged supervisors to innovate or to conduct better livelihood strategies. The surveys indicate that the farmers whose pond area was located close to the mud volcano were particularly adaptive as depicted on Chart 5.2.**Chart** 5.2 summarises the relationship between the four responses by which Sidoarjo shrimp farmers built resilience and made efforts to stay in the shrimp industry business.

Chart 5.2 Resilience adeptness component



Sources: Field observation, 2013

The four means demonstrate that the farmers gave less emphasis to wider changes in the political management of the aquaculture sector in their resilience process, and

focused on increasing their production quality by maintaining, utilising and inventing various techniques including improved water filtering, and a movement to develop environmentally friendly cultivation methods. Such resilience methods can be classified as practical adaptive responses to the changing socio-ecological environment.

The first means focused on developing their awareness of the market needs and wants. This is a process that preceded the mud volcano. The failures from intensive cultivation methods and the entry of Alter Trade Japan (ATJ) brought enlightenment for Sidoarjo shrimp farmers in three ways. First, the ATJ introduced a new approach in producing eco shrimp to the shrimp farmers. They campaigned food safety, environmental sustainability, and social justice issues (Fitrianto, 2012). By campaigning those three issues, the ATJ developed a partnership with local shrimp associations and provided assistance programs to increase the shrimp farmers' knowledge and develop their awareness to those three issues.

Secondly, the ATJ educated the farmers in managing the shrimp in the post-harvest process. The ATJ assisted the farmers in keeping the shrimp fresh until sent to the ATJ's processing depots.

Thirdly, encourage the farmer to have organic standards. In having organic certification, the ATJ developed a role model in cultivating organic shrimp called KPTOS (Local organic shrimp farmer groups) who had 104 units of organic ponds in 2006. The KPTOS also involved 111 units of shrimp ponds in Jabon, Porong, Tanggulangin, Candi, Sidoarjo, and Buduran.

The ATJ's role in empowering Sidoarjo shrimp farmers, shows that human capital development is progressing, not only in response to market demand for high quality shrimp but also for extracting and utilising Sidoarjo's local wisdom in shrimp culture,[58] and adopting local wisdom with modern shrimp culture to increase their shrimp productivity

[58] A knowledge in shrimp culture that is passed from their parents and grandparents

Furthermore, the development of human capital also could be seen from the peer education system. There is a routine meeting in every trimester. In this meeting the farmers share their knowledge and experience to the other farmers.

All in all the shrimp farmers' awareness of the market needs and wants develop through their interaction with ATJ's programs in Sidoarjo, their endowment knowledge in shrimp culture, and their existing social interaction with each other. The shrimp farmers' awareness was intensified by the mud volcano. This awareness, allowed the farmers to communicate with each other in order to reach agreement to increase the quality standards. In this term, the role of the shrimp farmers' association is also vital in providing support to the farmers, and provided enhanced communication between farmers and policy makers.

The second means demonstrated the social capital (also discussed in chapter six) and human capital owned by the shrimp farmers. Within the shrimp farmers' ability to communicate with each other, and with their knowledge owned, they are able to draw upon their own capacities and resources, including identifying local vegetation used as a traditional medicine to replace chemical medicines. This also increased their environmental capital in the form of the mangroves on their farms. Also the use of aquatic animals such green shell mussel or crab as a biological water indicator is further evidence of new awareness. This component is part of a learning and innovation process in response to hazardous situations such as pollution and the mud volcano eruption.

The third means represents the three forms of capital shrimp farmers possessed. The combination among the shrimp farmers' ability to communicate with each other, the knowledge that they have developed, and the environmental capital they have developed, has led to the ability to anticipate any new possibilities and to seek alternative solutions. This is illustrated by changes in farmers' shrimp cultivation practices. For example, in Buduran sub-district farmers used crabs as a biological indicator of increased pollution, and coral and activated charcoal for their meandering multi-stage water filtration process. Another example is Sidoarjo farmers' ability to mix ingredients to make probiotics.

The last means was the ability to develop effective communication and networking systems (discussed in detail in chapter seven). The most important were the regulations of shrimp farmers' associations as a communication bridge among farmers and the government, the regular meeting of shrimp farmers, and the cooperation with PT ATINA and other international buyers. However, these three activities were dominated by the elites consisting of the leader of the association and big farmers. This domination suggests the importance of taking into account the wider local political-economic context as noted by Perruci and Pilisuk (1970) who point out the dominance played by small groups of people who have the economic and political power to capture the gains of local production systems.

5.7. Conclusion

The farmers' reaction toward environment changes has been influenced by their understanding of their livelihood system, and their experiences adapting to previous polluting events and the entry of new markets. As identified earlier, the Sidoarjo shrimp farmer faced considerable pressure from overseas buyers demanding food and shrimp products that met the standards for their international markets. Not only that, water pollution, diseases, and the mud volcano eruptions put more pressure on shrimp farmers. Directly or indirectly, those threats and hazards have influenced the shrimp farmers' behaviour in their daily activities in aquaculture. The events that preceded the eruption of the mud volcano influenced the resilience of shrimp farmers. As a result of the failure of intensive shrimp cultivation, farmers became aware of environmental changes and implemented cultivation methods based on ecological principles such as implementing organic aquaculture.

In 2006, at the time of the mud volcano, farmers had developed a suite of cultivation techniques that they were using to monitor and improve environmental quality in their ponds. Those techniques identified that intensified after the mud volcano were: adopting a silvofishery system that integrated shrimp culture and mangrove conservation; and developing a cultivation method that utilises living vegetation as a support system. Second, there were some shifts in production from shrimp to other aquaculture commodities that can adapt to a harsh or polluted environment. Third, farmers also started using organic or biological pesticides and organic or biological

fertiliser, which is an increase in human capital. Fourth, new techniques were developed in response to the mud volcano, namely practicing the meandering irrigation system as a filtering process, and the use of biological indicators to monitor pollution levels in the ponds.

The adaptation process that is demonstrated by the changing behaviour of the farmers in watering their ponds and the usage of vegetation for filtering the river water is consistent with Klein (2007); O. Tang and Musa (2011) observe that disaster forces people to adapt and be creative by changing their behaviour and habits.

In short, livelihood resilience can be built at various levels. It depends on the degree of understanding of the existing livelihood and its changes, but also depends on the quality of human capital that consists of knowledge, past experience, and level of education. Besides the quality of human capital, resilience also influences access to the physical and environmental assets including technology and material for creating experiments and trials to build resilience. To provide a holistic understanding about the shrimp farmers' livelihood especially at a point in time six years after the mud volcano, the next chapter will describe and analyse the various classes of capital in the Sidoarjo shrimp industry.

CHAPTER 6. A LIVELIHOOD MAP OF SIDOARJO SHRIMP FARMERS: SIX YEARS AFTER THE MUD VOLCANO IN PORONG

Chapter three described the development of the shrimp industry over time focusing on how the development of human and physical capital equipped the shrimp farmers to respond to the water pollution from the mud volcano. As described in that chapter, in 2011 there were 15,488.07 hectares of shrimp ponds in Sidoarjo located in 8 sub districts. (DKP Kabupaten Sidoarjo, 2012). This chapter describes the condition of shrimp farmers' livelihood at a point in time six years after the Porong mud volcano began erupting. This section describes and analyses three types of capital that were not addressed in chapter five: social capital, physical capital, and financial capital. These three types of capital, and the environmental and human capital from chapter five, constitute the five types of capital found in the Sustainable Livelihoods Framework (SLF) assets pentagon for shrimp farmers. This chapter also addresses one aspect of human capital due to its close relationship with social capital: length of tenure in the shrimp industry, which correlates with knowledge of shrimp farming.

Chapter six considers what types of capital the respondents considered were most significant in building resilience, and what increased the vulnerability of the different categories of workers and the industry as a whole. It does this for two geographically distinct groups of shrimp farmers: farmers in regions greatly affected by the river pollution from the mud volcano, and farmers in regions less affected by the pollution. The chapter provides more specific data to augment and refine the broad conclusions drawn at the end of chapter five regarding how shrimp farmers' capital enabled them to broadly maintain their livelihood strategies despite the polluted river water. It combines data from both chapter five and six in order to holistically assess shrimp farmer responses to the mud volcano using the asset pentagons described in chapter four.

This chapter consists of six sections. The first section describes shrimp pond working arrangements and tenures as social and physical capital. It includes three aspects

shrimp farmers identified as important: the physical conditions of ponds (including the size and type of the pond), shrimp cultivation methods and the workplace environment. The second section describes the residential arrangements and work practices (social capital). The third section describes the income, expenditure and household size of the shrimp ponds' workers as well as linking issues of expenditure and household size to the regional economy (financial capital). The fourth section discusses the capital assets of the target and control groups, using the assets pentagon (using data from chapters five and six). The preceding chapter demonstrates the resilience of shrimp farmers in utilising their assets. This section uses this information to compare the responses of farmers who were in regions affected, and not affected, by the river pollution from the mud volcano. The fifth section discusses the findings. The last section is the conclusion.

6.1. The shrimp pond working arrangements and tenures.

This section describes the physical capital, human capital, and social capital of the shrimp industry in Sidoarjo. The degree of physical assets possessed by Sidoarjo's shrimp farmers, is demonstrated via several key characteristics of the pond premises: size by area; estimated monetary value; the type of pond medium used; and the method of cultivation. The shrimp pond work force arrangements represent the descriptions of human capital and social capital of Sidoarjo's shrimp farmers.

This analysis is based on the field survey and semi-formal interviews with shrimp farm owners. Interviews on this topic were limited to shrimp farm owners, the group most able to provide accurate assessments and estimates.

6.1.1. Estimated size and value of pond premises

Several survey questions that were directed towards the pond owner group established that the majority of shrimp aquaculture operations were of relatively small scale and value. This research divided surveyed ponds into three categories: small, medium and large. Small scale ponds have less than 10 hectares of pond; medium scale ponds have between 10 and 30 hectares; large scale ponds have more than 30 hectares. In Sidoarjo, the average pond area is 4.83 hectare (DKP Kabupaten Sidoarjo, 2011).

Table 6.1 shows that approximately 58 percent of all surveyed owners had ponds covering less than 10 hectares and a further 31 percent had ponds of 10 to 19 hectares. However, distribution differed between the target and control groups. The majority (67 percent) of ponds owned by the target group were less than 10 hectares in size compared to 44 percent of ponds owned by the control group. For the control group, ponds between 10 and 19 hectares in size were the most common category. At the top end of the scale, 6 percent of the total owner group had pond premises of 30 hectares or more and 4 percent had more than 40 hectares, while the target group had a greater percentage of larger ponds.

Table 6.1 Shrimp pond area by location by owner

Area (Ha) of ponds by owner	Target group (mud affected water source)		Control group (Non mud affected)		Total Research Group	
	f	Percent	*f*	Percent	*f*	Percent
<10	58	66.7	22	44	80	58.39
10-19	20	23	23	46	43	31.39
20-29	1	1.1	4	8	5	3.65
30-39	3	3.4	0	0	3	2.19
> 40	5	5.7	1	2	6	4.38
Total eligible respondents	87	100	50	100	137	100

Source: Fieldwork survey questionnaire data, 2013

Table 6.2 shows that approximately 74 percent of all owner respondents estimated that the value of their pond premises was under Rp1.5 billion (A$150,000). Just over 6 percent of respondents valued their shrimp pond at more than Rp2.5 billion (A$250,000). However, the majority (54 percent) of shrimp farm owners in the research target group had ponds that had a value less than Rp0.5 billion (A$50,000), the lowest bracket provided, compared to just 4 percent of the control group. Thirty one percent possessed ponds with a value around Rp0.5 billion to 1.49 billion (A$ 50, 000 to 149,000). In general the target group were generally less well off than the control group.

By contrast the majority of control group farmers (52.3 percent) valued their pond at between Rp0.5 billion to 1.49 billion or A$50,000 to A$149,000. A further 33 percent owned a pond with a value of Rp1.5 billion-2.49 billion or A$150,000-A$250,000. In summary, despite a lower percentage of the control group having a large pond, a greater percentage of this group valued their ponds in the top bracket than was the case for the target group. The reason why the ponds that are located in the control group tend to have a higher value, is because banks refuse to take the risk of lending money for investment in the area that is close to the mud volcano (Yahya, 2007). For this reason the land and property near the mud volcano have lower values compared to the area further from the mud volcano.

Table 6.2 Comparative estimated value of shrimp pond premises by target and control group

The estimated value of shrimp enterprises premise (in Rupiah)	**Target group (mud affected water source)**		**Control group (Non mud affected)**		**Total**	
	f	**Percent**	***F***	**Percent**	***f***	**Percent**
< 0.5 billion	36	53.73	2	4.76	38	34.86
0.5-1.49 billion	21	31.34	22	52.38	43	39.45
1.5-2.49 billion	7	10.45	14	33.33	21	19.27
2.5-3.49 billion	1	1.49	2	4.76	3	2.75
3.5> 4 billion	2	2.99	2	4.76	4	3.67
Total eligible respondents	67	100	42	100	109	100

Source: Fieldwork survey questionnaire data, 2013

There are at least two more reasons land and property nearest to the mud volcano has lower values compared to the ponds further away from the mud volcano. Firstly, the Porong area had subsidence rates of 0.1–4 cm/day during the June 2006 and September 2007 surveys (Abidin, Davies, Kusuma, Andreas, & Deguchi, 2009; Fukushima et al., 2009; Williams & Wibowo, 2009). Maintaining those subsidence rates, within 26 years the land subsidence in Porong would be between 95 and 475 m (R. J. Davies, S. A. Mathias, R. E. Swarbrick, & M. J. Tingay, 2011) and secondly, the content of heavy metals in samples of shrimp meat and shrimp gills was higher

than the content of heavy metals detected in the samples of pond water (Samsundari & Perwira, 2011).

Distributions across the type of medium used were reasonably similar to the target and control groups. This is because the geographic position of Sidoarjo is located on the delta river area of the Brantas Rivers system which is very fertile and adequate for brackish or salt water culture. Furthermore, in Sidoarjo, legally there are no organic ponds, but the facts show that most of the traditional ponds in Sidoarjo are still practicing and following the organic principles.

6.1.2. Pond type by water salinity

Pond type was heavily influenced by location. As shown in Table 6.3 approximately 53 percent of the total research shrimp farm owner group stated that their pond used salt water.

Table 6.3 Pond type by water salinity

Pond type by water supply	**Target group (mud affected water source)**		**Control group (Non mud affected)**		**Total**	
	f	**Percent**	***F***	**Percent**	***f***	**Percent**
Brackish water (combined with nearest river)	37	42.53	19	38	56	40.88
Fresh water (originated from nearest river)	5	5.75	4	8	9	6.57
Saltwater (estuary)	45	51.72	27	54	72	52.55
Total eligible respondents	87	100	50	100	137	100

Source: Fieldwork survey questionnaire data, 2013

These ponds were located closest to the coast. Forty one percent of the farmers used brackish water combined with the nearest river water and approximately 7 percent used fresh river water only in their aquaculture ponds. Distributions across the type of medium used were reasonably similar for the target and control groups.

6.1.3. Shrimp Cultivation Method

Indonesian shrimp farmers are generally thought to apply two main cultivation methods: semi-extensive and extensive aquaculture (Accenture, 2013). However, the survey data indicated that Sidoarjo has three types of shrimp cultivation methods: traditional ponds or Extensive ponds, Semi-Intensive ponds, and Intensive ponds.

According to male interviewee 1, a local tiger shrimp farmer, the Extensive Method has stock densities around 1-3 shrimp per square meter with a maximum yield around 0.6 up to 1.5 metric tons per hectare per year. This method uses natural tidal flows for aeration and has less frequent water exchanges. It is mostly applied for polyculture ponds that cultivate tiger shrimp and milk fish. The Extensive Method yields a maximum of two harvests per year.

The Semi-Intensive Method of shrimp culture has stocked densities of approximately 3 to 10 shrimp per square meter and annual yields from around 2 up to 6 metric tons per hectare. This method requires up to 25 percent of the total volume of pond water to be exchanged daily with fresh warm water originating from the nearest river or estuary. The Semi-Intensive Method is mostly applied for white shrimp (*Vannamei*) and some farmers use it in polyculture that combines *Vannamei* and *Oreochromis mossambicus* (a local shrimp known as *Nila mujaher*) (Male interviewee 1 and male interviewee 4). In some areas in the field work, I was able to observe that some farmers also applied the Semi-Intensive Method for tiger shrimp and milk fish polyculture.

The Intensive Method has stocked densities at 10-50 shrimp per square meter. This method has a maximum annual yield at around 7-15 metric tons per hectare. The intensiveness of this method requires more frequent water exchanges equivalent to over 30 percent of the pond volume per day. Further, this method requires a

mechanical aeration system for providing adequate oxygen to the water. Most Intensive ponds were using several water wheels for the aeration (male interviewee 1).[59]

When asked what types of cultivation methods were currently employed by pond owners in the survey area, most (90%) said they used traditional cultivation methods l (see Table 6.4). This was as high as 98 percent in the control group. In the target group, practices were slightly more diverse although eighty five percent were practicing traditional cultivation methods.

Nevertheless there was a 13 percent difference between the control and target groups in the number practicing traditional methods. One weakness with this data is that respondents were ambiguous about what constituted a traditional or an organic method. This is because in the past, most of the respondents were the partner of PT ATINA[60] and had organic certification until May 2008.

Table 6.4 Shrimp cultivation methods by target and control group

The cultivation method implemented	**Target group (mud affected water source)**		**Control group (Non mud affected)**		**Total**	
	f	**Percent**	***F***	**Percent**	***f***	**Percent**
Traditional (Extensive)	74	85.1	49	98	123	89.78
Semi intensive	9	10.3	0	0	9	6.57
Intensive	1	1.1	1	2	2	1.46
Organic	1	1.1	0	0	1	0.73
Others	2	2.3	0	0	2	1.46
Total eligible respondents	87	100	50	100	137	100

Source: Fieldwork survey questionnaire data, 2013

[59] There are two techniques, one using traditional feed made by farmers themselves, and the other using fabricated feed made by industrial producers.

[60] As describes in the preceding chapter, the partner of PT ATINA was sparse in six subdistricts namely Jabon, Porong, Tanggulangin, Candi, Sidoarjo and Buduran.

As male interviewee 2 explained "in Sidoarjo, legally there are no organic ponds, but the fact shows that most of the traditional ponds in Sidoarjo are still practicing and following the organic principles". Male interviewee 4 supported interviewee 2's comment that most Sidoarjo shrimp farmers still practice organic cultivation methods even though they have no agreement with PT ATINA. Additionally, based on an interview with a representative of PT ATINA, farmers who were the former holders of the organic shrimp certification[61] and continue to have cooperation with PT ATINA were acknowledged as farmers who cultivate Eco-shrimp.[62]

6.1.4. Shrimp pond work force arrangements

This subsection portrays the combination of different types of capital that are derived from social capital due to the interactions between pond owners, pond workers and supervisors. The relationship between shrimp farm owners and shrimp pond workers (including supervisors) in Sidoarjo tends to adhere to the patron-client model as discussed earlier. Pond owners provide for most of the workers' (including supervisors') needs, especially during critical stages in the shrimp production/cultivation process. Workers mainly reside and work in the shrimp pond area to maintain the pond and monitor the shrimp. Pond owners provide a place of residence and simple kitchen for workers in exchange for protection of the pond and its contents.

Shrimp pond work arrangements generates social capital for shrimp farmers. The more employees, the more social influence the owner has. For example, one shrimp farmer who is well-known as a successful shrimp farmer that employs many people in his ponds, has the ability to influence the head-of-village election. Respondent number 3 revealed that when there was a head-of-village election, he has to play neutrally accordingly. However, in certain circumstances he must provide some clue to his employees to whom should they give their vote. When people asked him about

[61] During 2002-2008, Sidoarjo shrimp farmers had organic certification from Naturland , an IFOAM (International Federation of Organic Aquaculture Movement) accredited certifying body.

[62] Eco-shrimp means that the shrimp production was produced through environmental friendly cultivation procedures.

his support, he just put his pointer finger in his mouth as a signal for the people to do not ask that question again. But by putting his pointer finger, this is also interpreted as support to vote for the candidate number one. This example is one of vertical social capital possessed by the shrimp pond owners.

Field observations also revealed that shrimp pond workers typically resided in the shed located near the ponds, and also had other sources of income. Owners often permit workers to utilize land around the ponds for planting vegetables or raising livestock and poultry such as lambs, goats, duck, and chicken. This phenomena demonstrates how the shrimp pond workers have a right in utilising land around the pond (environmental capital) for having other additional income.

Further, when conducting the survey and interviews at harvest time in Sedati and Jabon, another phenomenon was revealed. I saw some child and female workers were involved. When I investigated further, I found that it was common practice for the wives and children of all the three occupational categories to help with the shrimp harvest. This underage and unpaid family labour in the field sometimes included extended family. In other words, the wife was also contributing to the livelihood of the family through unpaid subsistence work. Her labour provided for the needs of the husband who was working on the pond.

Table 6.5 details the number of workers employed at ponds captured in the full survey sample. Consistent with the predominance of small and medium ponds, the majority of shrimp owner respondents reported having between 1-3 employees and less than 8 percent had 10 or more employees.

Field observations also revealed examples of female family members filling unpaid administrator roles for their parents or spouse. These informal practices, based on social capital, remain common in rural Java. Further, the finding above along with the research of Andrada (2015) indicates some traditional fisher folk women, particularly housewives, assist their husbands in daily fishing activities as well as contributing unpaid family labour for cooking, cleaning and other domestic chores.

Table 6.5 Number of shrimp pond employees per shrimp farm

The number of employees	*F*	Percent
1 employee	47	34.8
2-3 employees	50	37.0
4-9 employees	28	20.7
10-14 employees	7	5.2
15-20 employees	2	1.5
> 20 employees	1	0.7
Total eligible respondents	135	100

Source: Fieldwork survey questionnaire data, 2013

According to Harmadi (2011) 20 percent of 2.8 million underage workers in Indonesia are working in the agriculture sector. A child worker in this sector is usually utilized as an economic asset by their parents. Some research demonstrates that child workers can contribute up to 25 percent of total family income (Edmonds & Pavcnik, 2005; Harmadi, 2011; Woodhead, 2004).

Underage labourers are also paid less and in some circumstances may not be paid at all. According to Woodhead (2004), and O'Donnell, Rosati, and van Doorslaer (2005) the involvement of underage workers in the agriculture activities has physical and psychosocial consequences. This is because the agriculture sector involves chemical herbicides or pesticides, exposure to heat or extreme weather, repetitive work with the potential to easily trigger injuries for children, and threats posed by animals, reptiles, insects, parasites and some venomous plants. As result, education is interrupted, and many child workers drop out of school (Harmadi, 2011).

Another finding from field observations is the involvement in harvesting by people who reside near a pond's location, and are not employees of the shrimp pond. They participate because they are allowed to scavenge low grade fish, mangrove crabs, or

other molluscs such as mussels, scallops or clams, that can be found in the pond after the main crop has been harvested.

This involvement of local people during the harvest is part of local custom called "*gotong royong*" or working together. *Gotong royong* is a reciprocal relationship among Javanese communities. One tiger prawn farmer (male interviewee 2), also underlined that community involvement in the harvesting or other pond activities not only increased the community income, but also provided benefits to pond management. The community would voluntarily help the security of the pond at the time of harvesting through informal monitoring.

Further, the field observation revealed that the ponds located in Buduran, Sedati, Waru and Sidoarjo sub districts have more casual workers compared to the ponds located in Tanggulangin, Porong, Jabon, and Candi. In regard to the effects of the mud volcano, it seems casual and contracted workers in Tanggulangin, Porong, and Jabon are the most affected due to losses in productivity. However my interviews indicated that workers in Tanggulangin, Porong, and Jabon seem to have found other jobs in the same sector outside Sidoarjo, such in Pasuruan District and Probolinggo District. Migration of workers following the mud volcano eruption requires further research.

All in all, social capital is often exchanged for different types of capital that benefit workers, supervisors and owners. Expectations about wages, and permission to use, and utilise the pond area are regulated through social capital within shrimp farmer communities.

6.2. Residential arrangements and work practices

Residential arrangements and work practices can increase physical capital, social capital, and human capital. The road infrastructure that connects the worker from their residential area to the work place are categorised as physical capital. The relationship between the residence of the worker and work place is important as the majority of the shrimp pond employees (63 percent) lived close to their place of work, and a further 27 percent lived and worked in the same subdistrict.

Furthermore, the field observations revealed that shrimp farm supervisors and workers tend to live in simple cabins on the pond owners' property close to the ponds to conduct everyday tasks. Most, particularly those with school aged children, had a home elsewhere that they returned to for several days every two weeks or so. However, in several survey locations I found that a shrimp pond worker's spouse also lived in the cabin. Some of these couples were older with adult children; others had younger children who lived elsewhere with grandparents. The implications for informal labour are discussed further below (subsection6.3.3)

Table 6.6 Employee's residence and place of work

The distance of employee's resident	***f****	**Percent**
Reside near to the pond location	104	62.28
Reside elsewhere in the same sub-district (*kecamatan*)	45	26.95
Reside outside the sub-district, but still in the same district (*kabupaten*)	11	6.59
Outside the district (*kabupaten*)	7	4.19
Total eligible respondents	167	98.25

*the research group could give more than one answer

Source: Fieldwork survey questionnaire data, 2013

Field observations also revealed that having a local workforce is advantageous to owners as shrimp farm supervisors and workers are typically available to work extended and irregular hours depending on the stage in the shrimp cycle.[63] After the farmer spreads the shrimp fry on the pond, workers are watching, observing, and managing any kind of support required for the shrimp juveniles to grow. Supervisors of two or less workers also tended to stay in the cabin to coordinate and manage the

[63] The relative and the close relationships are not solely variables that are measures of trust, but the family bonds and cultural closeness make the pond owner more comfortable to employ them in their ponds.

pond with the worker(s). The supervisor of three or more employees tended to check fortnightly. This is because many supervisors are responsible for more than one pond. Pond owners are usually only present in their ponds for controlling the use of pond supplies such shrimp/fish feed or fertilizer, but tend to come frequently in the first month of pond preparation and the three weeks before the harvest.

6.2.1. The research group experience in the shrimp industry workforce

Instead of formal education, length of time of experience in the shrimp industry influences the level of workers' skill. These subsections portray the position of human capital in the shrimp industry. Table 6.7 reveals that the survey respondents had been involved in the shrimp industry for different periods of time. The majority of owners (56 percent) had been involved more than ten years compared with 34 percent of supervisors and just 18 percent of workers. By contrast the majority of workers had five years or less experience in the shrimp sector.

The supervisor group was more evenly distributed across the different levels of experience, suggesting a steady progression through the industry. Interview data revealed that most supervisors start as shrimp pond workers for a couple of years. Once they have adequate knowledge or skill they were offered a higher position as a supervisor. Supervisors still do some aquaculture jobs, but they have additional responsibilities as the coordinator and supervisor of other shrimp workers.

Table 6.7 Respondents length of time in shrimp industry

Length of time	Owners		Supervisors		Workers		Total	
	f	Percent	*f*	Percent	*f*	Percent	*f*	Percent
< 1	2	1.45	7	3.66	80	24.24	89	13.51
1-5	9	6.52	60	31.41	123	37.27	192	29.14
5-10	49	35.51	57	29.84	65	19.70	171	25.95
> 10	78	56.52	67	35.08	62	18.79	207	31.41
Total eligible respondents	138	99.28	191	97.95	330	99.40	659	98.95

Source: Fieldwork survey questionnaire data, 2013

6.2.2. The research group's working tenure in the shrimp industry

Working tenure is one component in creating a conducive working environment. Working tenure influences the livelihood of shrimp farmers, both as pond owner (provide a job vacancy) or as pond worker (provide labour). Based on field observation and interviews, working tenure arrangements varied considerably between the target research population (near to the mud volcano) and the control group (far from the mud volcano). I consider working tenure arrangements separate to financial capital because it relates to social capital (the bonds between workers, supervisors and owners formed over time and at times across generations, and how they generate loyalty and trust).

Tables 6.8 and 6.9 describe remuneration methods for the research survey target group and control group respectively. Fifty one percent of the total target group indicated that their remuneration method was through commission. However, the remuneration method varied across the occupational groups. Seventy percent of the worker group indicated that they received remuneration by another method, which was casual daily payment. However, more than 66 percent of the owners and almost 93 percent of the supervisors answered that their remuneration was through commissions.

Table 6.8 Remuneration method in the target research population

Total	Owners		Supervisors		Workers		Total	
	F	**Percent**	***f***	**Percent**	***f***	**Percent**	***f***	**Percent**
Weekly payment	1	1.16	2	1.56	12	5.19	15	3.37
Monthly payment	2	2.33	2	1.56	2	0.87	6	1.35
Commissions	57	66.28	119	92.97	53	22.94	229	51.46
Profit Sharing	18	20.93	0	0	2	0.87	20	4.49
Others	8	9.3	5	3.91	162	70.13	175	39.33
Total eligible respondents	86	100	128	100	231	100	445	100

Source: Fieldwork survey questionnaire data, 2013

By contrast the difference between the target group and the control group is that the majority of the target group stated that the remuneration method that had been implemented was commission and the control group has a higher percentage being paid through profit sharing. Interviews and field observation revealed that the profit sharing model is more common among Sidoarjo shrimp pond workers, owners and supervisors. Profit sharing practice varies depending on the agreement between the owner and the worker. In one example, a pond owner in Buduran[64] (male interviewee 2,) who was well known as a successful tiger shrimp farmer received one eighth (12.5 percent) of the profits plus a bonus. One-eighth profit sharing means that all the revenue that obtained is reduced by all the expenses. The balance that remains is divided into eight parts and the twelve point five percent of the remaining balance is the salary of the worker.

Table 6.9 shows more than 64 percent of the control group stated that their remuneration was paid via the profit sharing principle, and a further 24 percent had been paid using commissions. Further, a scant 10 percent of them received their salary monthly, and none weekly.

[64] Buduran is located relatively far from the mud.

Table 6.9 Remuneration method in the control group

Remuneration method	Owners		Supervisors		Workers		Total	
	F	**Percent**	***f***	**Percent**	***f***	**Percent**	***f***	**Percent**
Weekly payment	0	0	0	0	0	0	0	0
Monthly payment	2	4	8	12.9	10	10.2	20	9.52
Commissions	24	48	19	30.65	7	7.14	50	23.81
Profit Sharing	23	46	35	56.45	77	78.57	135	64.29
Others	1	2	0	0	4	4.08	5	2.38
Total eligible respondents	50	100	62	100	98	100	210	100

Source: Fieldwork survey questionnaire data, 2013

Male interviewee 3, another successful *Vannamei* shrimp farmer in Tanggulangin[65] applied the same formula. The profit sharing that is generally offered to the worker/manager is between 10 and 25 percent of the profits of the crop. The owner provides all the equipment and material that is needed for shrimp culture. The shrimp farm owner pays all of the workers' and supervisors' expenses. The shrimp pond worker is paid when the shrimp pond is harvested.

6.3. Income, expenditure and household size

The following section describes income, expenditure and household size for Sidoarjo shrimp farmers, which relates in particular to the financial capital available for the three different categories of shrimp farmer. This analysis is based on the field survey and semi-formal interviews with three different groups of research respondents, shrimp farm owners, work supervisors and shrimp pond workers.

6.3.1. Monthly income of shrimp farmer

Measuring a shrimp farmer's income is difficult. This is because the shrimp farmers' income is not only from the shrimp culture. Some were running other businesses or have jobs in other sectors.

Discussions with participants during the field survey revealed there have been changes in the recreation time and activities of shrimp farmers linked to changes in their work situation. "…in the past, we often to go to Tretes or Trawas,[66] twice or three times a month, but now, once in two months is never achieved, "[67] said some of farmers who gathered near the pond when they took a break from pond work. Further discussion revealed that their leisure time has changed because they have less income compared to the past time.

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[65] Tanggulangin is located relatively close to the mud.

[66] Tretes and Trawas are well known places for leisure and holidays in East Java

[67] *"… dulu kita pergi ke Tretes atau Trawas sebulan bisa dua atau tiga kali, Lha sekarang boro boro sebulan sekali, dua bulan sekali saja tidak kesampaian*"

In order to simplify the earning of shrimp farmers, this research asked about monthly income. The total survey group were asked to estimate their monthly income from their activities in shrimp culture with the results summarised in Table 6.10.

In general, seventy percent of respondents had a monthly income greater than Rp2,000,000 (A$200) and 35 percent had a monthly income of more than Rp2,500,000 or (A$ 250). The table shows the differences in earning capacity between the three occupational groups. The majority of shrimp farm owners (79 percent) was clustered in the highest earning category, that is, category F with incomes equal to or greater than Rp2,500,000 (AUD 250 per month), with a further 11 percent in category E with incomes between RP2,000,001 and Rp2,500,000 (AUD 50-250 per month). By contrast the reported incomes of both the supervisors and the workers' groups were more evenly distributed across the range.

Nevertheless the largest percentage of supervisors and workers (45 percent and 38 percent, respectively), reported being in the second highest category of income (E) and 17 percent of supervisors and 28 percent of workers were in the highest category. These phenomena could be explained by the income diversification processes observed in the field.

As mentioned above (section 6.1.4), some workers were permitted to stay in the pond premises and utilised the land near to cabins for supporting their daily life activities. Some of them are also raising poultry such as chickens and ducks. The income that is gained from side activities as indicated above made several of the workers' wages higher than their supervisors.[68]

[68] The income questionnaire was designed for querying about the shrimp pond income which originated from shrimp industry, however the field research showed that many of the workers who stay in the pond proximity are also planting vegetables and also raising poultry.

Table 6.10 Survey respondent income earning from shrimp industry

Income per month		Owners		Supervisor		Workers		Total	
		f	Percent	*f*	Percent	*f*	Percent	*f*	Percent
A	Rp100,000-Rp500,0000	0	0.00	1	0.53	8	2.42	9	1.37
B	Rp500,001-Rp1000,000	3	2.19	23	12.11	44	13.33	70	10.65
C	Rp1,000,001-Rp1,500,000	3	2.19	21	11.05	27	8.18	51	7.76
D	Rp1,500,001-Rp2,000,000	8	5.84	26	13.68	30	9.09	64	9.74
E	Rp2,000,001-Rp2,500,000	15	10.95	86	45.26	127	38.48	228	34.70
F	> Rp2,500,000	108	78.83	33	17.37	94	28.48	235	35.77
Total eligible respondents		137	100	190	100	330	100	657	100

Source: Fieldwork survey questionnaire data, 2013

The following analysis looks at income in the two different locations. The target group located near to the river that was polluted by the mud flow shows that more than 46 percent of the respondents have a monthly income between Rp2, 000,001-Rp2,500,000 (A$ 200-A$250) and more that 35 percent of the respondents have monthly incomes of over Rp2,500,000 (A$250). Again, there were differences between owners, workers and supervisors. The majority of owners (76 percent) had monthly incomes of more than Rp2, 500,000 (A$250) whereas the majority of supervisors (59 percent) had monthly incomes between Rp2, 000,001-Rp2,500,000 (A$ 200-A$250), and the majority of the worker (52 percent) had monthly income between Rp2, 000,001-Rp2,500,000 (A$ 200-A$250). See Table 6.11 for details.

Table 6.11 The range of monthly shrimp incomes for the target group

Income per month		Owners		Supervisor		Workers		Total	
		f	Percent	*f*	Percent	*f*	Percent	*f*	Percent
A	Rp100,000-Rp500,0000	0	0.00	0	0.00	1	0.43	1	0.23
B	Rp500,001-Rp1000,000	1	1.15	5	4.07	11	4.74	17	3.85
C	Rp1,000,001-Rp1,500,000	3	3.45	7	5.69	12	5.17	22	4.98
D	Rp1,500,001-Rp2,000,000	4	4.60	19	15.45	23	9.91	46	10.41
E	Rp2,000,001-Rp2,500,000	13	14.94	72	58.54	120	51.72	205	46.38
F	> Rp2,500,000	66	75.86	25	20.33	65	28.02	156	35.29
Total eligible respondents		87	100	123	100	232	100	442	100

Source: Fieldwork survey questionnaire data, 2013

In comparison, data on the incomes of the control group shows some differences. The majority of this group of respondents (38 percent) has monthly incomes of more than Rp2, 500,000 (A$250). There were 84 percent of the owner respondents in this area also have a monthly income more than Rp2, 500,000 (A$250). Further, in the supervisor group almost 47 percent of these respondents have a monthly income above Rp1, 500,000 (A$150). For the highest income range of over Rp2,500,000, the proportion of the workers in this category was higher (almost 30%) than that of supervisors (just 13%) (see Table 6.12)

Table 6.12 The range of monthly shrimp income of control group

Income per month		Owners		Supervisor		Workers		Total	
		f	**Percent**	***f***	**Percent**	***F***	**Percent**	***F***	**Percent**
A	Rp100,000-Rp500,0000	0	0.00	1	1.61	7	7.14	8	3.81
B	Rp500,001-Rp1000,000	2	4.00	18	29.03	33	33.67	53	25.24
C	Rp1,000,001-Rp1,500,000	0	0.00	14	22.58	15	15.31	29	13.81
D	Rp1,500,001-Rp2,000,000	4	8.00	7	11.29	7	7.14	18	8.57
E	Rp2,000,001-Rp2,500,000	2	4.00	14	22.58	7	7.14	23	10.95
F	> Rp2,500,000	42	84.00	8	12.90	29	29.59	79	37.62
Total eligible respondents		50	100	62	100	98	100	210.0	100

Source: Fieldwork survey questionnaire data, 2013

Based on data of Statistics Indonesia, Indonesian per capita income in 2012 was Rp30,674,674.07 (BPS, 2014), or Rp2,556,222.84 monthly. This suggests that income for almost 78 percent of surveyed shrimp farm owners were close to or above the Indonesian per capita income[69]. The average income of each respondent category is: the owner has average income more than Rp2,500,000.00 (more than A$250/Month). The Supervisor has an average income between Rp1,500,000,00-

[69] Comparing the shrimp farmer monthly income with income per-capita just to demonstrate the shrimp farmers' monthly income is above the income per capita, not adjusting these two calculations as similar terms.

Rp2,000,000 per month (A$ 150-A$200 per month) and the worker has an average income between Rp2,000,001-Rp2,500,000 (A$50-A$250) per month However, more than 44 percent of supervisor respondents and more than 38 percent of workers surveyed had a monthly income between Rp2,000,000-Rp2,500,000 (A$ 200-A$ 250).

The majority of respondents had a reported income at or above the Sidoarjo minimum wage of Rp2,190,000 per month in 2014 (East Java Governor decree number 78 2013). However, 10.2 percent of owners had a reported income from shrimp farming below the Sidoarjo minimum wage standard, as did 35.4 percent of supervisors and 32.8 percent of shrimp pond workers.

The income and working conditions of survey respondents is considered as a good indicator of the wider condition of shrimp farmers. Referring to the SLF scheme and theory, access to income are part of the financial assets of shrimp farmers (I return to this in section 6.4.3) and the working conditions are categorised as a social asset owned by shrimp farmers (see section 6.4.2).

Based on interview data, aquaculture provides the largest source of revenue for most of the households of the respondents. Male respondents numbers 2 and 12 revealed that the village community who stay near the pond area and mangrove area can make syrup from the mangrove fruit and mangrove flour. The mangrove that could be used for syrup is the apple mangrove (local people called as *bogem*; *Sonneratia alba*) and the mangrove that could be processed to make flour is *Bruguiera gymnorrhiza* also known as large leafed orange mangrove or local people called *putut* tree. Many spouses of the shrimp pond workers are involved in processing mangrove fruits. The mangrove syrup and mangrove flour is to become a commodity that could generate income for the shrimp worker.

6.3.2. Survey group expenditure

The survey provided data on expenditure. Table 6.13 shows monthly expenditures for owners, supervisors and workers. Some 34% of shrimp pond owners spent between Rp1,000,000.00 and Rp1,500,000 per month. Almost 28% spent between

Rp1,500,000.00 and Rp2,000,000.00 per month, while the remaining 30% spent more than Rp2,000,500.00.

Comparing the three groups of respondents' spending shows different trends. In all three groups of respondents the majority monthly spending is approximately Rp1,000,000 – Rp1,500,000. per month, but the second largest group is quite different. The workers' second biggest group spends between Rp500,001 - Rp1,000,000, and for the supervisor, the second biggest group spending is Rp1,500,001 - Rp2,000,000. This trend is similar to the spending distribution of the owners. This survey revealed that the supervisor and pond owners have the same monthly spending at around Rp1,500,001-Rp2,000,000.

Table 6.13 Survey respondent expenditure for daily living

Expenditure per month		Owners		Supervisors		Workers		Total	
		F	**Percent**	***f***	**Percent**	***F***	**Percent**	***f***	**Percent**
A	Rp100,000-Rp500,0000	0	0.00	4	2.11	14	4.23	18	2.74
B	Rp500,001-Rp1000,000	10	7.30	27	14.21	65	19.64	102	15.50
C	Rp1,000,001-Rp1,500,000	47	34.31	67	35.26	230	69.49	344	52.28
D	Rp1,500,001-Rp2,000,000	38	27.74	55	28.95	11	3.32	104	15.81
E	Rp2,000,001-Rp2,500,000	19	13.87	23	12.11	6	1.81	48	7.29
F	> Rp2,500,000	23	16.79	14	7.37	5	1.51	42	6.38
Total eligible respondents		137	100	190	100	331	100	658	100

Source: Fieldwork survey questionnaire data, 2013

Further, more than 69 percent of the workers recorded have expenditure around Rp1,000,000-Rp1,500,000 (A$100-A$150) while the other group of spending had just less than 5 percent of respondents except in the segment B that consists 19.6 percent of respondents.

The spending level has a correlation to household size. Larger families report greater monthly expenditure. On the following chart can be seen that the majority of those three groups of respondents have 2-4 family members who reside in their house. Less than 30 percent of the respondents have more than four family members in their houses.

However, shrimp farmers' income trend and their spending show wide disparity. The majority of respondents income categorised in segment C, that is, a monthly expenditure among Rp1,000,001 - Rp1,500,000. For some, their monthly earning is segment F which means that they have income more than Rp2,500,000.00 per month.

6.3.3. Household size

The majority of households in all shrimp farmer occupational categories reported having between 2-4 household members. As represented in Table 6.14, 74.64 percent of shrimp farm owners have 2-4 family members, almost 70 percent of supervisors have 2-4 family members and more than 90 percent of shrimp worker have 2-4 family members.

Table 6.14 Survey respondent household size by occupational group

Number of families	Owners		Supervisors		Workers		Total	
	f	**Percent**	***f***	**Percent**	***F***	**Percent**	***f***	**Percent**
2-4 people	103	74.64	133	69.63	294	90.18	530	80.92
5-6 people	31	22.46	53	27.75	23	7.06	107	16.34
7-10 people	3	2.17	3	1.57	8	2.45	14	2.14
> 10 people	1	0.72	2	1.05	1	0.31	4	0.61
Total eligible respondents	138	99.28	191	97.95	326	98.19	655	98.35

Source: Fieldwork survey questionnaire data, 2013

There were more than 22 percent of shrimp owners, almost 28 percent of supervisors and more than 7 percent of the workers who had between 5-6 family members. Less than five percent of these occupational groups had more than seven family members.

Within the description of the research group family members above show that the majority of the respondents have responsibility over their nuclear family and just 18 percent of the research group have responsibility for housing and feeding their extended family.

As demonstrated in Table 6.15, the vast majority of the members of the surveyed Sidoarjo shrimp farmer households, (79 percent), were of working age, or between the age 15 years old and 64 years old.

Table 6.15 Age distribution for all household members for the total survey group

Age range	Frequency	Percent
1-14 Years	452	20.21
15-65 Years	1757	78.58
65+ Years	27	1.21
Total eligible respondents	2236	97.43

Source: Fieldwork survey questionnaire data, 2013

Twenty percent of all household members were under official working age and only 1 percent is above working age or 65 years and over. Therefore the dependency ratio for the total respondent group is 27.15 percent, meaning that for every 100 people of working, or productive age there are 27 dependents.

Table 6.16 suggests that the shrimp pond worker group has a slightly higher dependency ratio compared to the other two groups. However, the youth dependency ratio is greater than the older dependency ratio for all three respondent occupational groups. Further detail shows that the youth dependency ratio is, however marginally, higher for the worker group, and older dependency is the highest in the owner group.

Table 6.16 Age range of all household members by respondent's occupation

Age range	Owner		Supervisor		Workers	
	f	Percent	*f*	Percent	*f*	Percent
1-14 Years	87	17.40	127	18.73	238	22.50
15-65 Years	403	80.60	543	80.09	811	76.65
65+ Years	10	2	8	1.18	9	0.85
Total eligible respondents	500	100	678	93.91	1058	99.34

Source: Fieldwork survey questionnaire data, 2013

Compared to East Java Province Statistic (2015) data, the above survey results suggest that the dependency ratio among Sidoarjo shrimp farmers may be

significantly lower than East Java and Sidoarjo dependency ratios of 44.3 percent and 45.7 percent. However, this comparison needs to be treated with great caution. The dependency ratio is a simple measure typically used at a larger regional or national scale to identify trends over time relating to potential pressures of an economically dependent population on a given economy.

A further limitation is that the dependency ratio is based on the assumptions that: first, no one outside the official working age is generating an income; and second, that everyone in the working age bracket is actively employed.

The survey about the household members revealed that around 76.65-80.60 % of each group are in age range 15-65 years old. In some circumstances the older people also help in harvest time with monitoring, counting, or doing unpaid administrator roles in helping the breadwinner roles in shrimp culture. Further, the field observation show both the workers and supervisors tend to have help from their spouse and child in the field. This finding shows that the shrimp farmers have adequate man power in conducting adaptive strategies in facing the environment changes such as maintaining the irrigation or conducting such other physical work in shrimp culture.

6.4. Capital assets of the two groups

As discussed previously, while the mud eruption in Porong did not directly inundate shrimp ponds, government policy has been to divert the mud flow to the nearest river, which created a burden for the communities that used the river water as a key resource for their livelihoods, including shrimp farming.

There are five types of assets that built shrimp farmers' livelihoods. Those assets are environmental, social, human, financial and physical. According to DFID (1999) a community's vulnerability can be identified through the degree of access by communities to their assets, and the terms of exchange between different types of assets.

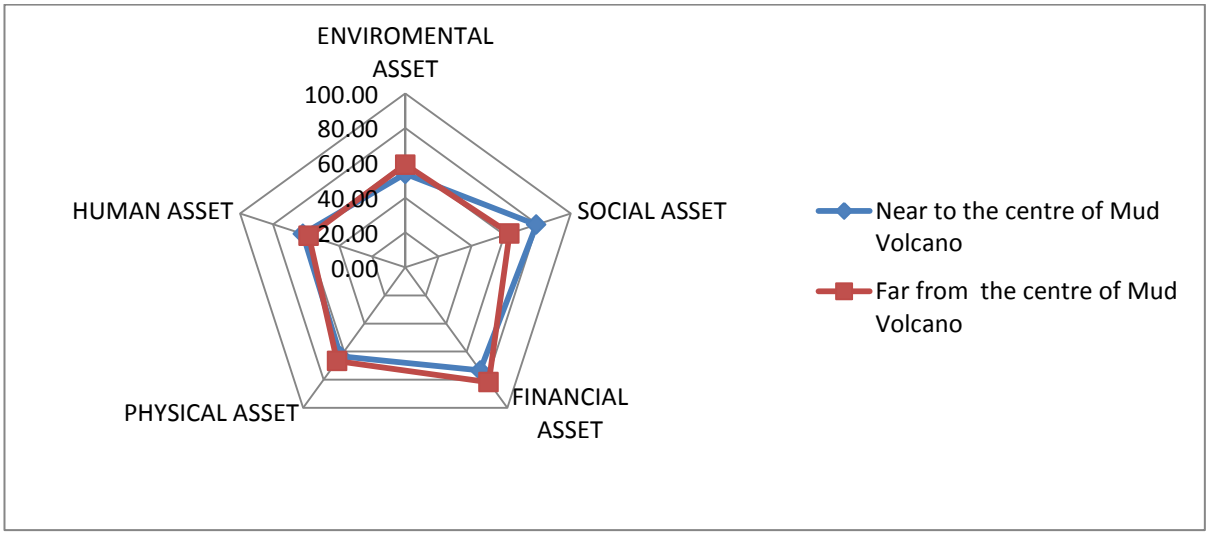
Whether intentional or not (Gurung & Kollmair, 2005) and (Robbins, 2012, p. 91), the government policy for water disposal influenced shrimp farmers' vulnerability. In

this section it is demonstrated how shrimp farmers' vulnerability was shaped by their variable access to a range of assets clustered within the broad categories of Livelihood Pentagon Assets. The access of Sidoarjo shrimp farmers to the five categories of assets discussed above are summarised in the Chart 6.1.

The categories of assets identified above and collected through the field research are discussed in chapter 5 and chapter 6. The categorisation of assets and the measurement of asset access develop based on the scorings of each assets group described in section 4.3.4.

At a glance, there are small differences in access to assets between the target and control groups in environmental, human and physical assets, with noticeable differences between the groups in the categories of social and financial assets. The target group has two advantages compared to the control group in the categories of human and social assets.

Chart 6.1 The access to assets by target group and control group in Sidoarjo



Source: Fieldwork survey questionnaire data 2013

6.4.1. Access to environmental assets

Chart 6.1 shows there was little difference in access to environmental assets between farmers located closer or further from the centre of the mud volcano. For shrimp

farmers in Sidoarjo, the most critical environmental asset is the river water. Research reported that the Porong and other rivers nearby were polluted by the mud flow (Antara, 2009; Down to Earth, 2006; Herawati, 2007).[70] The polluted rivers are widespread and disturbed the shrimp productivity especially in the early stage of the mud volcano event.

Despite the burden for farmers dependent on river water affected by the mud volcano, there were some advantages in the form of reduced sea abrasion and an increased pond fertility of the coastal area. Six years after the mud volcano, the mangrove area close to the mud volcano expanded as a result of the creation of a new island named Sarina Island in the Porong river estuary (Pahlevi, 2010, 2013; Putro, 2015). Sarina Island was (in 2015) 80 hectares wide and entirely planted with mangrove. Further, the presence of the sludge reservoir (spoils bank) in the Porong estuary inhibited the strong flow of sea water from the Madura Strait and reduced northerly winds entrance to the aquaculture area (Pahlevi, 2010, 2013; Putro, 2015). Also, the nutrient-binding properties of the mud was better than that of the sand (BPLS, 2009). Better costal environment conditions reduced sea abrasion and increased the fertility of the coastal area benefitted the aquaculture sector.

6.4.2. Access to social assets

Chart 6.1 shows that the access to social assets by farmers located close to the centre of the mud flow was higher than for those located far from the mud flow. This access gap can be seen in five indicators.

The first indicator is that many shrimp industry stakeholders came to the aid of the farmers. For example, Brawijaya University and the Sepuluh November University of Technology Surabaya conducted several research projects on the impact of the mud volcano toward fisheries in Sidoarjo and provided recommendations on how to manage the poisonous mud.

[70] This research has been discussed in the introduction chapter

The second indicator is government support. The survey revealed that more than 77% of the target research group agreed, with almost 20% agreeing strongly, that they needed government support in reducing the effects of the mud volcano eruption in Porong and that government should allocate more funding in supporting that effort. The research group expectation was paralleled by government actions seen from the revision of the Sidoarjo district spatial plan and the provision of a special budget allocation for supporting the community affected by the mud volcano. This budget allocation can be found in Sidoarjo's RPJMD[71] document.

The third indicator is farmer association support. The survey demonstrated that the research group continued to have effective communications and relationships with each other and other shrimp farmers. Shrimp farmers became closer to each other because they felt vulnerable and needed to cooperate to find solutions to their problems. The position of shrimp farmer associations as glue in gathering the shrimp farmer through their routine programs and meetings as explained in the previous chapter (section 5.6).

The fourth indicator is market access. The market orientation of Sidoarjo shrimp production is for export with almost 54% of the shrimp pond owners stating that more than 50% of their pond production was for export. The local market demand absorbed 36% of production (see Table 3.7), 64% of Sidoarjo shrimp production was sold outside Sidoarjo, regionally, nationally or internationally

The fifth indicator is that of the working remuneration system. The interviews and field observation revealed that the profit sharing model was the common model of Sidoarjo shrimp pond working tenure. Profit sharing practices varied depending on the agreement between the owner and the worker. The profit sharing remuneration model was able to strengthen the relationship between the pond owner and the worker.

[71] RPJMD- *Rancangan Pembangunan Jangka Menengah Daerah* - the long-term development plan of the local government

6.4.3. Access to financial assets:

Chart 6.1 shows that shrimp farmers located near to the centre of the mud volcano had less access to financial assets than those further away. This finding is supported by two pieces of evidence; first, the survey revealed that ponds located in the control group tended to have a higher value as they were considered by the banks and financial organisations as less risky investments as they were further from the mud flow. (Fitrianto, 2009; Yahya, 2007).

Second, the pollution caused by the mud threatened buyer confidence in buying and trading the fisheries' products of Sidoarjo. The buyer aversion to Sidoarjo fisheries' products reduced their demand for Sidoarjo fisheries' products. This created financial problems for the Sidoarjo shrimp industry.

However, in terms of income from their ponds, approximately 75% of respondents in the target group had incomes of more than Rp2 million (A$200) per month, while just 48% of the respondents in the control group had this income level. The owners of the ponds in the target group had higher incomes compared to the owners far from the mud flow, a trend followed by supervisor and worker groups.

The reason for this was that more pond owners in the target group applied polyculture practices than farmers in the control group.[72] I found many farmers in Jabon cultivated shrimp and milk fish (*Ikan Bandeng* or *Canos canoes*) and also seaweed in their pond, which meant they had more income sources than the control group. Furthermore, when I visited Jabon, along the road that runs in line with the Porong river bank, I found several ponds had been used for sand mining. Farmers stated that sand mining, in addition to being profitable, also assisted with digging up the ponds without using expensive manual labour. The second reason was that the pond location was easily accessible to large trucks that transported the sand.

As described in section 6.4.1, the mangroves in Candi, Tanggulangin. Porong and Jabon are denser and wider compared to the mangroves in Sedati, Waru, Buduran

[72] Applying polyculture is also categorised as a physical asset in term of technology applied

and Sidoarjo. Compared to areas that have less dense mangroves, dense and wide mangroves are able to accommodate more living marine biota, such as crab, green clam, scallop or bivalves. These resources are additional commodities for the farmers.

6.4.4. Access to physical assets

Access to physical assets as depicted in Chart 6.1 show almost no difference in access between the two geographical survey locations. There are no companies or institutions that have established hatchery services in Sidoarjo. The Sidoarjo shrimp farmers obtained their shrimp fry from outside of Sidoarjo, much of it supplied by a company located in Gresik and Situbondo.

In terms of physical size, there was only a 0.3% difference in the number of medium and small ponds between the two areas. As shown in tables 6.1 and 6.2, 89.7% of medium and small ponds were found in the target group compared with 90% in control group.

According to the records of the Sidoarjo Marine and Fisheries Department (2000), the average pond ownership of the individual aquaculture farmer was between 2 to 5 hectares. Whereas the survey shows that the target group had wider ponds of over 30 hectares (9.1% compare 2%), this means that more than 12.5% of the shrimp farmers in the target area and 56% of the shrimp farmers in the control group, had bigger and wider ponds compared to the average size of Sidoarjo's shrimp ownership.

The ponds near the mud volcano had higher subsidence rates of 0.1–4 cm/day during the June 2006 to September 2007 survey period. (Samsundari & Perwira, 2011) also revealed that the content of heavy metals in samples of shrimp meat and shrimp gills was higher than that detected in samples of pond water, making the aquaculture ponds in this area less valuable. This reduced land and property values in the area (see Table 6.2).

In terms of transportation infrastructure, there are no major differences between the target and control group areas. The ponds located near the estuary use boats or transportation organized privately by individuals or by the aquaculture association.

There is no government involvement in providing water transportation. However, the survey revealed that the target group had less access to this physical asset compared to the control group. Since 2013, the transportation facility in the surrounding areas has been interrupted by the growing mud lake.

In regard to access to technology, farmers located far from the centre of the mud volcano had more opportunities to access new technology and techniques in aquaculture. For example, the meandering irrigation filtering water system was more advanced in ponds far from the mud volcano compared to those near to the mud volcano. All in all this section indicates there are geographical differences in the uptake of new techniques and practices.

6.4.5. Access to human capital

A major factor in developing community resilience is the quality of human capital. Human capital takes several forms such as length of experience in a particular activity, working age, education background, and their past experience (Milgram, 1990). This postulate has been strengthened by Klein (2007); Tang and Musa (2011). Disaster forces people to adapt and be creative by changing their behaviour and habits. Data on human capital used in Chart 8.1 is drawn predominantly from chapter five, but also chapter six due to its close relationship with social capital. According to Chart 8.1, there is little difference between the two areas in regard to human capital.

In terms of experience, both areas surveyed show a similar trend. The majority of the shrimp farm owner had been involved in the shrimp industry for more than ten years, whereas the supervisor group was more evenly distributed across the different levels of experience. The majority of workers had five years or less experience in the shrimp sector. In addition the vast majority of the members of the surveyed Sidoarjo shrimp farmer households were of a productive and working age.

I have already provided a number of examples of increasing human capital (see Table 6.17).

Table 6.17 Changes to Human Capital before and after the Mud Volcano

	Before the mud volcano	**After the mud volcano**
Control group	The farmers just conduct their daily routine activities	Due to the distance, have much opportunity in practicing and experiencing new technology such as practicing meandering irrigation in filtering river water.
Target group	The farmer could add to or change the water in their shrimp ponds, on a needs basis.	The farmer must consider mud disposal schedule operated by the BPLS and the tidal schedule, to reduce the potency of contaminated water to enter the pond
Dispersed across groups	Had adequate earning from shrimp ponds and recreation time. (often to go to Tretes or Trawas,[73] twice or three times a month)	Has less earning and cannot afford to have proper recreation time (desire to visit Tretes or Trawas once in two months is never achieved) [74]

Source: Fieldwork data, 2013

[73] Tretes and Trawas well known as places for leisure and holidays in East Java

[74] *"… dulu kita pergi ke Tretes atau Trawas sebulan bisa dua atau tiga kali, Lha sekarang boro boro sebulan sekali, dua bulan sekali saja tidak kesampaian*"

6.5. Discussion

Livelihoods based around shrimp pond aquaculture are determined by a range of social, ecological, economic and institutional factors. Distress, pressures, shocks and hazards threaten livelihoods both immediately and over time (Cannon, Twigg, & Rowell, 2003; Douglas Paton, 2001 ; Oliver–Smith, 2004; Smit & Wandel, 2006; Turner, 2004). Livelihood vulnerability is a depressing state (Adger, Benjaminsen, Brown, & Svarstad, 2001), which has external and internal dimensions. The external dimensions include the environmental hazard and policies changes whereas the internal dimension include the human resources quality and their preparedness in anticipating the damaging loss.

As depicted at Chart 6.1, the target group has two advantages compared to the control group in the categories of human and social assets. Chart 6.1 assists to identify the different assets possessed by quantifying the asset, making comparisons between assets, and creating a quantifiable indicator of assets in order to seek sequencing or substitution between assets.

Most shrimp farmers in developing countries, especially small-scale operators face many challenges. They have to deal with the lack of access to good quality feed and seed; limited access to transportation services; high-risk of disease; difficulty in fulfilling market needs, such as food safety standards, traceability and certification; and limited access to markets and fluctuating shrimp prices.

The survey and observation revealed several changes in the livelihood of Sidoarjo shrimp farmers. The degree of significance of the change varies among the target and control groups.

There are at least three livelihood transformation identifiers due to the occurrence of the mud volcano in Porong. First, the changes of ponds as financial assets and environmental assets. Sub section 6.1.1 shows that the target group had a greater percentage of larger ponds. However, the ponds that are part of the control group tend to have a higher value. These contradictive findings show that the mud volcano created uncertainty in pond price appraisals. Furthermore, in some instances, the mud

volcano also influenced the productivity of the farmers causing the farmers' annual income to decrease.

An extreme livelihood transformation has been found in Jabon sub district. Due to the pond productivity reducing gradually, the pond owners changed their ponds to sand mining sites. This phenomenon has been found in an area along the road running parallel with the Porong river bank. The reason behind those changes was that sand mining is more profitable where fish and shrimp cultivation was not. This is because sand mining in the area does not use manual man power that costs a lot of money, rather they use a high pressure pump that is able to suck sand from the bottom of the pond cheaply. The second reason is that the pond location is easily accessed by the large trucks that transport the sand. However, in other places, shrimp farmers still utilise their ponds as fisheries.

Possessing ponds, besides functioning as a place for production activities (physical asset), can also be used as collateral for a loan or having a bank loan (financial asset) and increase the owner's social status (social asset). Pond ownership functions as a social asset in three ways. First the amount of ponds owned increase the social status of shrimp pond owners. This is because when the farmer in harvest time, if they make a substantial profit, they tend to give alms[75] to religious organisations such for the mosque and donations are announced during worship, creating community respect for the donor.

Second, by possessing ponds, there is an ability to develop a good relationship with the community. The good practices that have been found for this case is the existing local wisdom that allows people to stay near the pond for scavenging low grade commodities in the shrimp pond (as described in 6.1.4). This creates togetherness among the owner and the community who live in close proximity to the shrimp ponds. As result of these social advantages, the shrimp farmer can refine their

[75] Most of shrimp ponds' respondents are Moslem. In Islam, values have been taught that the more income that has been earned the more social responsibility is embedded, therefore annually every Moslem has to donate a portion of their income for *Zakat, sodaqoh*, and *infaq* (religious charity) besides paying tax.

livelihood strategies, in particular in adopting polyculture, which has increased the income of the target group, even though they have less access to loans (Yahya, 2007). The more a shrimp farmer is acknowledged as a generous person, the more easily the farmer gains help from the community. In the case of adopting polyculture, which requires intense labour in planting mangrove and creating other pond instruments, the shrimp pond owners are able to employ with backward salary.

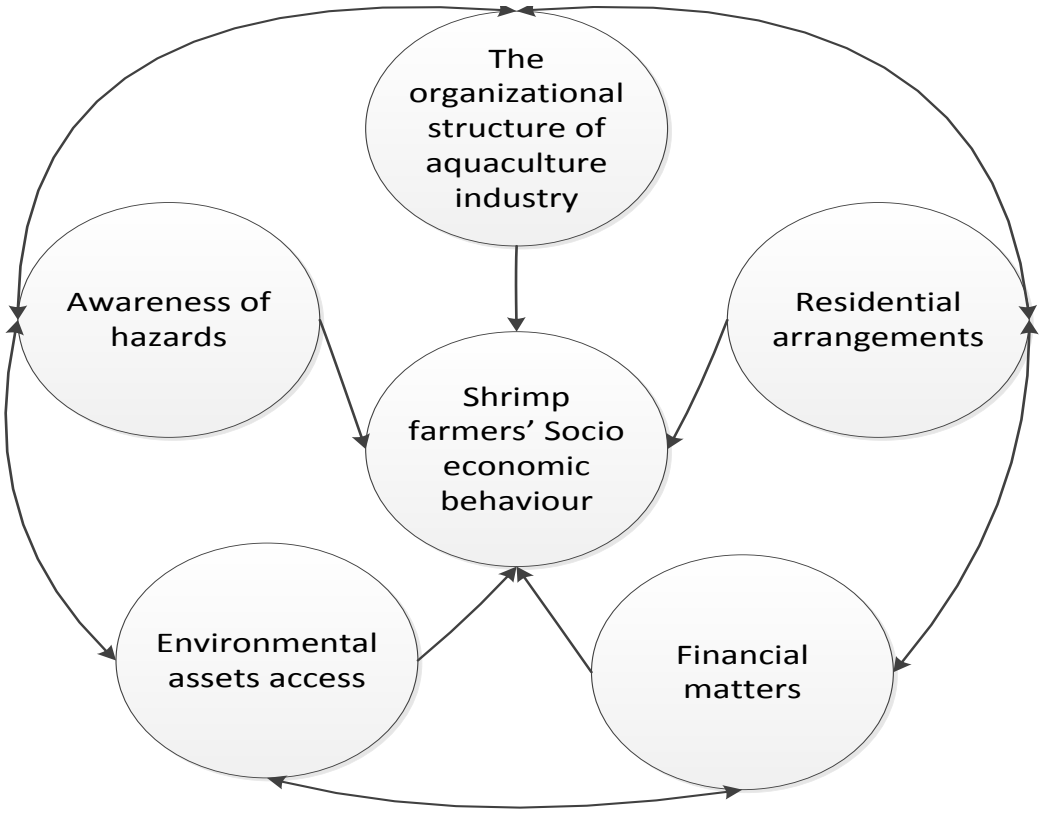
Changes to the shrimp farmers' livelihood, especially when they apply polyculture, show that the target group who apply polyculture is larger than the control group. There are 68 farmers in Kupang village cultivating shrimp, milk fish and seaweed in their pond, while no farmers in other subdistricts advised that they cultivate seaweed.

Third, the capital exchange across local communities and shrimp pond owners can be seen from the involvement of the community who reside around the pond for pond maintenance jobs. For this model, there were two capitals that were exchangeable: financial capital (source of income) and labour demand. The shrimp pond owner provides jobs (has labour demand) in maintaining the pond and for the community this is the source of income. An example of a pond maintenance job that involves the community is planting the mangrove. In addition, while employing the community for planting mangrove, the pond owner is also able to educate and develop community awareness of the importance of mangroves to their region. The advantages of engaging the local community is that the community has empathy and concern for environmental conservation. Therefore, they will be more ready to participate in environment conservation activities. This includes creating an independent mangrove watchdog. The objective of having an independent mangrove watchdog is to control illegal mangrove logging. The community that has become involved with the issues of conservation of industry, environment and income has the courage to maintain a watch upon the mangroves. In addition, the involvement of the community against the illegal mangrove logging also has as a goal to reduce the number of community members who may have been tempted to commit theft and illegal harvesting of mangroves.

The transformations, especially in shrimp farmers' socio-economic behaviour, have been influenced by five factors; (i) social capital especially the organisational

structure of the aquaculture industry, (ii), a combination between physical capital and social capital that is represented by residential arrangement and work practices, (iii) financial aspects, (iv) the quality of human capital, especially about the awareness to the hazard and the effects of the mud to the production, and (v) the degree of environmental assets access and asset vulnerability identified through the degree of pollution of water river.

Chart 6.2 The factors that influence shrimp farmers socio economy behaviour



Sources: Field observation, 2013

All in all, in terms of the degree of asset access and asset vulnerability, the farmer whose ponds are located near to the mud volcano have more access to human assets and social assets compared to the farmer whose ponds are located far from the centre of the mud volcano. Whereas the Sidoarjo shrimp farmers whose ponds are located relatively far from the centre of the mud volcano have more access to the

environmental, physical, and financial assets. However, the differentiation accesses to each asset are very small. This means that the vulnerability degree among the two geographical areas are almost similar and it can be concluded that six years after the mud volcano the socio-economic condition of the shrimp pond owners, supervisors and workers in affected area had significantly recovered.

6.6. Conclusion

Considering the similar access to assets of the two groups of Sidoarjo shrimp farmers six years after the mud volcano, it can be seen that there has been considerable resilience within the industry. This chapter explores the reasons for this resilience through an assessment of the access to different types of capital amongst the three types of shrimp farmer employment, and compares target and control groups to understand if and how shrimp farmers more proximate to the mud flow responded in different ways to farmers who were more removed.

The chapter demonstrates that instead of the threat of the mud volcano to the shrimp farmer livelihood especially in reducing income, (shown by the farmer recreation time changes), it is the social values that the shrimp farmers' community believe are supporting their own resilience processes. For example, in particular, access to physical assets for workers (simple cabin, land for growing food crops) leads to access to unpaid labour for owners, a financial saving.

The second evidence is through allowing local people to scavenge low value commodities on post-harvest ponds and by involving local community in maintenance of the mangrove. This creates financial assets for the community and leads to access to unpaid security to protect shrimp theft and against illegal mangrove logging.

All in all, in the six years post the mud volcano eruption, the socio-economic condition in the vicinity has recovered. This conclusion has been supported through the survey results that show very small differentiation accesses to five assets that

have been observed. The degree of vulnerability among the two geographical areas is similar.

After having demonstrated the livelihood map of Sidoarjo shrimp farmers, six years after the mud volcano in Porong, the next chapter analyses the supply chain changes of the Sidoarjo shrimp industry. Chapter seven will turn the attention from the capital asset of shrimp farmers to the the institutions and proceses that were available to address the effects of the mud volcano eruption in Porong.

CHAPTER 7. THE SUPPLY CHAIN CHANGES OF SIDOARJO SHRIMP FARMERS

This chapter analyses how key transforming structures and processes changed due to the mud volcano disaster in Porong. It turns its attention from the capital assets of shrimp farmers to the institutions and processes that were available to them to address the effects of the mud volcano. The key institutions are shrimp farmers' associations and government agencies. In addition, this chapter suggests that changes of the shrimp industry supply chain have influenced the shrimp farmers' capacity to create sustainable shrimp culture. Therefore, in this chapter, supply chains are considered as a transforming process as it is a set of institutionalised relationships within the shrimp industry. The chapter also assesses government interventions to assist Sidoarjo shrimp farmers after the eruption of the mud volcano.

According to Butler and Mazur (2007), understanding the construction of supply chains[76] assists community members to deal with livelihood problems. Through understanding the supply chain behaviour, the shrimp farmers are able to learn and anticipate possible events that cause loss and injustice, or provide better access to livelihood resources (Morse, 2013, p. 31).

This chapter consists of six sections. The first section describes in brief the Sidoarjo shrimp industry supply chain six years after the mud volcano. The second section reveals shrimp farmers' perspectives about the interaction between shrimp farmers and shrimp farmers' associations. The third section portrays shrimp farmers' perspectives about the government response. This section also analyses the Sidoarjo government budget allocation in supporting aquaculture, and documents various policy responses to the mud volcano. The fourth section describes shrimp farmers' access to markets. The fifth section is the discussion. This section addresses differences in opinions and contradictory analyses found between the field survey

[76] In this term, the contexts of social networks have been interpreted as the construction of supply chains based of the work of Grant (2001) that defines connectivity among community members as 'bonding' and 'bridging' social capital. Bonding social capital refers to `bonding' social interrelations within the group structure, and `bridging' capital refers to the type that links, or cuts across, different communities/groups (Narayan, 1999).

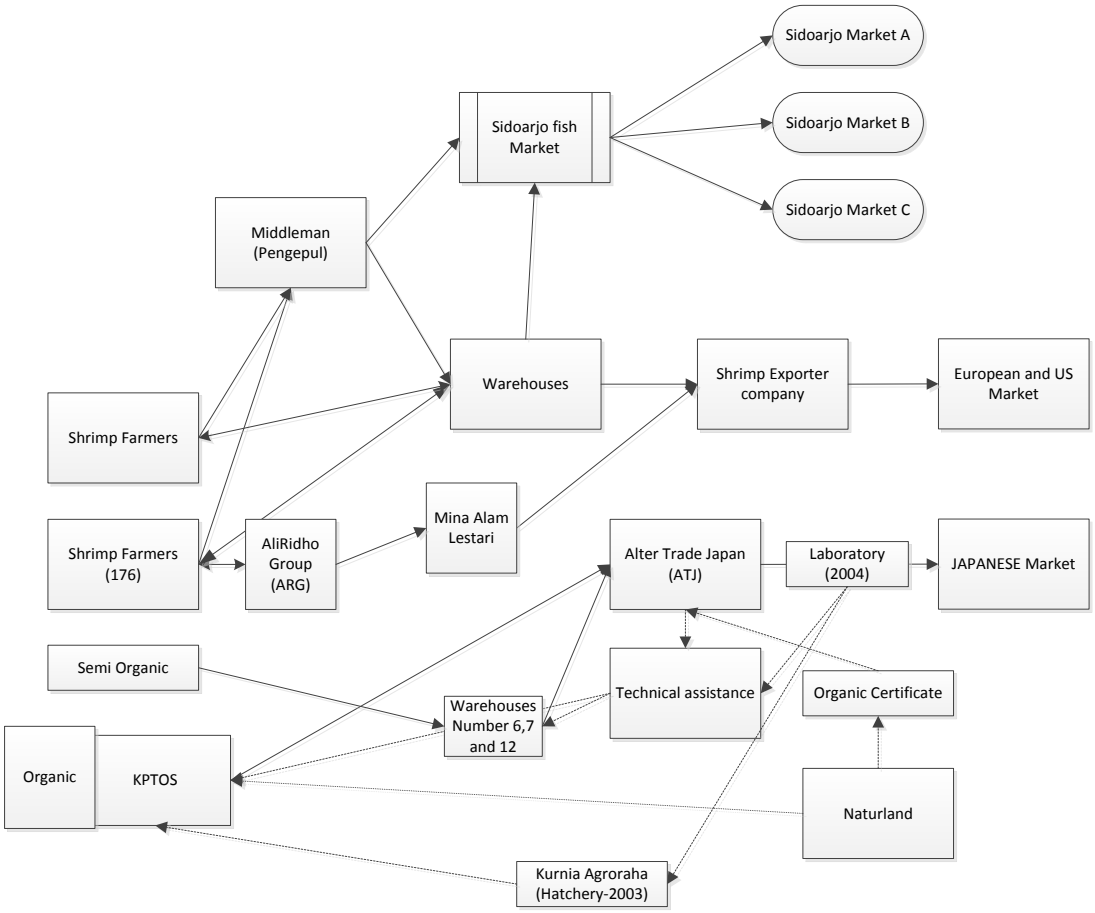
and observations related to the impact of the Porong mud volcano with regards to the social networking and the supply chain changes of the Sidoarjo shrimp farmers. The last section is the conclusion.

7.1. The Sidoarjo shrimp industry supply chain six years after the mud volcano

The preceding chapter demonstrated that the mud volcano and the mitigation action affected the wider environment and aquaculture sector in Sidoarjo. The Sidoarjo shrimp industry serves local, national, and international markets. In order to supply the market and create a sustainable agriculture system, the industry players have to be aware of any potential risks, such as, supply risk, demand risk, and environmental risk which could impact their sustainability. If a supply chain risk is managed correctly, organisations tend to remain profitable (Cousins et al., 2004; Hendricks & Singhal, 2005).

When the Sidoarjo shrimp farmers face threatening situations such as pollution and the mud volcano, the farmers need to take actions that can include changes to their aquaculture practices at the farm level and in relation to the wider supply chain (seed suppliers, shrimp feed suppliers, and other partners including their buyer). Changes to the supply chains can help to maintain economic performance and reduce the impact of risk on farmers (C. S. Tang, 2006). The following sections briefly explain the Sidoarjo supply chain changes before and after the mud volcano.

Chart 7.1 The partial supply chains of Sidoarjo shrimp farmers before the mud



Sources: Field Observation, 2013[77]

Chart 7.1 shows the supply chain of the shrimp industry in Sidoarjo before 2008.[78] There are at least four groups of intermediary traders in the Sidoarjo shrimp industry

[77] The double arrow show reciprocal relationship, on one side the farmer supplies products, on the other side, ware house or farmer association have significant role in persuade farmers choices as the supply shrimp seed, food and other essential resources.

[78] Two years after the mud volcano, most respondents stated that the real effect of the mud volcano widely affected Sidoarjo's shrimp industry, and specifically respondent number 2 revealed that it took around four years for the mud volcano particles to reach the pond in Buduran.

that significantly influence the Sidoarjo shrimp supply chains. The first one is Ali Ridho Groups (ARG).[79] ARG group had 250 members that managed 592 unit ponds in five sub districts; Sedati, Buduran, Sidoarjo, Candi and Tanggulangin. ARG supplied the ATJ[80] demand of extensive shrimp product until 2002.

The second group of buyers consists of suppliers or warehouses[81] who supply a range of inputs to shrimp farmers ranging from shrimp fry to shrimp feed. Most transactions that happened between the suppliers and shrimp farmers were paid at the harvest period. Therefore, farmers supplied by a certain warehouse are obliged to sell only to those warehouses and not to other warehouses or other buyers. Warehouses[82] sort the shrimp that was sold to them and categorized them into two categories. The first category is for the export market and the other for the local market. The export quality shrimp is sent to export companies and non-export quality distributed and sold on local markets (the local market will be discussed in section 7.4).

The third group of buyer consists of the middleman[83] or *pengepul*. *Pengepul* act as double agents, by which I mean both sellers to and buyers from shrimp farmers.

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[79] The Ali Ridho Group (ARG) was founded around 1984. It started as a club of shrimp farmers and the pond operational managers and eventually became a collector and supplier of shrimp for some export-oriented factory / packer / shipper (such as PT. Sugando Ksatria Foods Indonesia). Over time, the Ali Ridho Group became a kind of cooperative that provides assistance including funding, procurement of the pond production raw materials, marketing, and technical assistance. The ARG farmer members are conservative, traditional farmers, who rely on traditional ways in aquaculture processes, such as growing algae as natural food, and managing water based on the tides.

As a cooperative that supplies export-oriented factories, ARG applies the principle of traceability in the cultivation process. Traceability enables the ability to identify the origin of a product or goods. Therefore, from the initial process up to the packaging must be supervised and administrated. The producers of fry should have certification and be acknowledged as a trusted fry supplier appointed by the importer. Second, ARG as collectors of shrimp production must have equipment and facilities that meet the requested standard. This standardization, starts from the harvesting process, includes transportation to the warehouse, grading, sizing, packing and delivery to the factory.

[80] Alter Trade Japan, now days known as PT ATINA

[81] There are many warehouses in the Sidoarjo shrimp industry. This research focuses on those known as the initiator in promoting environmentally friendly aquaculture such ARG, ATINA, KPTOS, and Eco Shrimp

[82] Warehouses have two roles, as suppliers of inputs and buyers of shrimp

[83] *Pengepul* is a small trader

They buy and collect shrimp from farmers to supply the warehouse demand, and they buy the shrimp from farmers to supply the local market. Usually *Pengepul* gather the information about farmers who would like to sell their shrimp partially or other products of the pond from a *warung.*[84] Sometimes they meet with farmers and transact at local *warungs* (traditional stores).

The fourth group of buyer is PT ATINA.[85] PT ATINA buy shrimp from the farmers that are under the supervision of the KPTOS *(Kelompok Petani Tambak Organik Sidoarjo* - the Sidoarjo Organic Shrimp Farmers' Association).[86] This farmers' association is located in six sub-districts; Jabon, Porong, Tanggulangin, Candi, Sidoarjo and Buduran.

[84] *Warung* is a small traditional store that sell foods and drinks. *Warung* in this research are recorded as communities' (aquaculture farmers') informal information hubs. This is because when the farmer has a break time for lunch or has finished their work in the pond, they often drop into the *warung* for a small snack or to have coffee. I found this phenomena in Jabon and Sedati.

[85] PT ATINA and Sidoarjo shrimp farms obtained an organic certification Naturland German for six years (2002-2008)

[86] KPTOS *(Kelompok Petani Tambak Organik Sidoarjo* - the Sidoarjo Organic Shrimp Farmers' Association) had 104 units of organic ponds in 2006. In empowering their member, KPTOS had joint cooperation with PT ATINA. The cooperation among PT ATINA within the KPTOS's members were applied individually, PT ATINA selected the pond that fully filled the criteria stated in the Naturland certificate. The selected farmer signed a contract with PT ATINA. Having contracted with PT ATINA the farmer receives some benefits such as being educated on how to cultivate a good organic shrimp, or being supplied by PT ATINA with certified shrimp fry or shrimp feeds. Having supplied the shrimp fry and the shrimp feeds, farmers will pay for them at harvest time. By deducting from the overall harvest result that is sold to the PT ATINA, the farmers pay the total cost of supplying shrimp fry and shrimp feed. PT ATINA provided for and established the organic program in 6 subdistricts:, Sidoarjo subdistrict (which most people refer to as *Kecamatan Kota*), Candi, Tanggulangin, Buduran, Sedati, Porong and Jabon. Before the mud volcano, the joint cooperation between KPTOS and PT ATINA had been going for five years.

Photo 7.1 *Warung* that serve pond workers in Sedati and Jabon

Credit Photo: Author, 2013

Six years after the mud volcano, some of these actors had changed little. First, *pengepul* and warehouses still operate as double agents, buying shrimp and supplying inputs. Second, PT ATINA remained dominant in assisting and buying shrimp cultivated in environmentally friendly ponds from 70 shrimp pond owner members. At the time of the research, some 611,69 ha[87] of shrimp ponds exported shrimp to Japan. Third, ARG still played the role of export company supplier. Mina Alam Lestari is the main trading company which buys from ARG's farmer members and supplies several export companies with markets in Europe.

While these are the continuities, there have been four changes in the supply chains (see Charts 7.1 and 7.2). First, PT ATINA ended their cooperation with Sidoarjo shrimp farmers organised under KPTOS. This was due to events in 2008. On the one hand, the farmers accused PT ATINA of not being honest with farmers about their products (informant 1 and 2), and on the other hand PT ATINA found examples of fraud in transactions through mixing of organic and non-organic shrimp by farmers (informant 14). The members of KPTOS decided to discorporate the organization,

[87] Owned by 70 shrimp farmers as mentioned in preceding sentence

and farmers are still able to supply PT ATINA individually with their shrimp in a new scheme.

Second, in 2009, twenty five of the former members of KPTOS established a new shrimp association called Eco-Shrimp[88] in order to supply PT ATINA and the Japanese market, and in September 2009 PT ATINA established a hatchery in Situbondo. The purpose of the hatchery was to provide shrimp fry free from antibiotics in the post larval stage for Eco-Shrimp. Eco-Shrimp farmers were able to access credit from banks as their products were directly bought by PT ATINA and exported to Japan, and the loans were guaranteed by PT ATINA.

Third, PT ATINA changed their source of shrimp supply from Sidoarjo and started educating, empowering[89], and promoting environmental friendly shrimp pond production in Gresik, East Java, and Pinrang, Sulawesi

Fourth, the former committee of KPTOS became involved in several other organizations such as FKMT (Forum Komunikasi Masyarakat Tambak, Aquaculture Community Communication Forums)[90] and former KPTOS members spread into several local aquaculture farmer associations in each district. Most continued to practice the cultivation method that had been introduced when they were members of KPTOS as it was similar to the extended method or traditional method.

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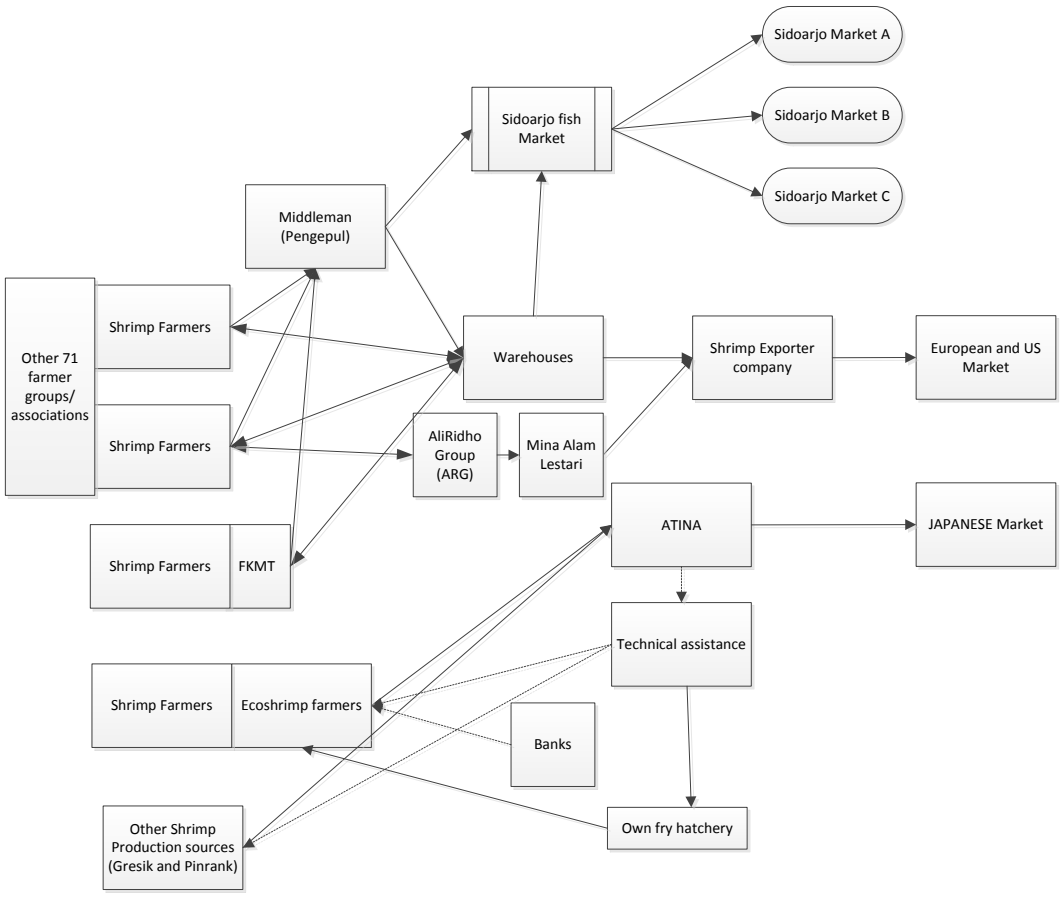
[88] Initially the members of this group consisted of 25 shrimp farmers, but based on information obtained from PT ATINA's vice general manager, the membership subsequently grew to 70.

[89] As explained in the proceeding chapter, the empowering program consists of a program for introducing new approaches in producing eco shrimp, post-harvest assistance programs, and organising organic certification

[90] The FKMT was established in 1988 and has the aim of maintaining and improving the quality of aquaculture production in Sidoarjo. FKMT is an organization that consists of aquaculture pond owners, aquaculture business practitioners and local governments. Through the establishment of FKMT it was expected to increase cooperation between the government and aquaculture farmers in increasing the quality and the productivity of the aquaculture. FKMT facilitates discussions related to the concept, program and operational coordination in the management of the fishery sector, especially the fields of ponds.

The changes are highlighted in Chart 7.1 and Chart 7.2. These charts show that the changes helped to anticipate and mitigate risk associated with the mud volcano.

Chart 7.2 the supply chain of Sidoarjo shrimp farmers after the mud volcano



Sources: Field Observation, 2013

The largest changes were driven by PT ATINA. From PT ATINA's perspective,[91] there was a need to evaluate the cooperation between the company and farmers to guarantee continued shrimp quality (male informant 14). Furthermore, the mud volcano heightened their concern and, according to female informant 9, the Japanese buyer regularly visited Sidoarjo to inspect pond practices.

[91] PT ATINA was not the most at risk from adulterated shrimp, but it was the first company that introduced eco-farming and initiated a campaign for conducting a traditional cultivation in shrimp industry since 1992

This example illustrates how the company sought to reduce risk by implementing supply chain risk management. It did so by recognizing the source of risk, addressing the possibility of any consequences, outlining the drivers of risk, and taking risk mitigation measures (Juttner et al, 2003). The company recognised that the environmental changes created potential hazards to the quality of shrimp if not managed well.[92] It also recognised that farmers' hardship could trigger a drop in standards and increase fraud in the production process. In response it provided routine inspection and random checking of production quality and set up a new agreement with the farmers to raise standards by establishing eco-shrimp as part of the supply chain risk management implementation.

From the shrimp farmers' perspective, their relationship to buyers has three aspects. First they have the opportunity to sell their shrimp to other possible buyers.[93] Second, they can seek greater independence by engaging in environmentally friendly shrimp culture using experience from when they had been supported by PT ATINA.[94] Third, they can develop local peer education schemes among the famers.[95] These three aspects of Sidoarjo shrimp farmer activities illustrate what Ritchie and Brindley (2007) explain as strategic steps in measuring risk performance. These steps include analysing performance risks and their consequences, responding to identified risks, and evaluating final outcomes.

The transformation structure demonstrated the efforts of shrimp farmers to reconstruct their supply chains in order to ensure their market and keep their livelihood continuous by eliminating the risks and disruptions that may occur in the

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[92] This information comes from an interview with the vice general manager of PT ATINA conducted on 5th of April 2013

[93] The secretary of FKMT stated that the evaluation agreement with PT ATINA provides a more competitive challenge to farmers to innovate and produce shrimp with high quality that could be offered to the other buyers. This is because PT ATINA just bought the shrimp in certain sizes.

[94] A farmer, member of ARG stated that within the assistances provided, and with the past knowledge from their parent and grandparent, the farmer is able to arrange an experiment in order to increase their shrimp productivity

[95] The chair of UPP revealed that the farmers have routine meetings in every trimester. In this meeting the farmers' share their knowledge and experiences.

future. The next section examines three factors or variables that increase the awareness of shrimp industry stakeholders to reduce the risks caused by both the mud volcano and disruptions to their supply chains. The degree and type of communication between shrimp farmers and shrimp farmer associations were important for shrimp farmers to position themselves effectively to continue to get access to international markets in particular. It also discussed shrimp farmers communications with government and their market orientation.

7.2. Communications between shrimp farmers and their associations

There were 3205 shrimp farm owners in Sidoarjo employing approximately 328 *Pandega* (shrimp pond worker) that spread across 8 districts, 31 villages and are organised into 71 fish farmers' associations (the Marine and Fisheries Department of Kabupaten Sidoarjo, 2011). The farmer associations influence farmers' behaviour in many ways. They play a significant role in increasing agricultural production, improving the welfare of farmers, fighting poverty, reducing environmental resource degradation, increasing women's involvement, as well as health, education, and social policies.

Among these 71 fish farmers' associations, as depicted in Chart 7.2, there are four shrimp farmers' associations that are very influential in Sidoarjo. Those organisations are FKMT (*Forum Komunikasi Masyarakat Tambak* - Aquaculture Community Communication Forums); ARG (Ali Ridho Group); KPTOS *(Kelompok Petani Tambak Organik Sidoarjo* - the Sidoarjo Organic Shrimp Farmers Association), and Eco-Shrimp Association.[96]

To examine the effects of the mud volcano eruption on communication between shrimp farmers and shrimp farmers' associations, the questionnaire asked the participants: "Is communication with the farmer associations effective?" The

[96] In 2009 the Eco-Shrimp Association became the second winner of a national competition in aquaculture and obtained first prize in 2010 at the same event. The Eco-Shrimp Association holds a national certification called CBIB Certificate (*Cara Budidaya Ikan yang Baik*-A good aquaculture technique). This certification is issued by Aquaculture Directorate General - The Fishery and Marine Ministry of Indonesia. The area that has been managed and cultivated by the Eco-Shrimp groups and has CBIB certificate is 611,69 hectares.

effective communication was measured from the regular association meetings, including regular workshops and upgrading skills among farmers and by direct phone or social media communication. Table 7.1 documents the results.

Almost 75 percent of the target research group agreed, almost 55 percent strongly, that they had effective communication with their shrimp farmer associations. More than 14 percent of the group were neutral and just over 11% disagreed (3% strongly) with the proposition. The control group showed less support for the effectiveness of communication with the farmer association with a majority opting for the neutral position. This data shows that approximately 75% of the research group supported or strongly supported communication with their associations.

Based on the occupational group analysis, Table 7.1 shows a higher proportion of the supervisors (91 percent), then workers (71 percent), and owners (62 percent), stated that their communications with their shrimp association have not been affected. This data show that the supervisors have more capacity to develop effective communication with shrimp farmer associations compared to the other two occupational groups.

Table 7.1 The effectiveness of farmers' association communication in the target and control group

Your farmers' association had more frequent communication after the mud volcano.	**Owners**				**Supervisors**				**Workers**				**Total**			
	Target group		***Control group***		**Target group**		***Control group***		**Target group**		***Control group***		**Target group**		***Control group***	
	f	**Percent**	***F***	**Percent**	***f***	**Percent**	***f***	**Percent**	***f***	**Percent**	***f***	**Percent**	***f***	**Percent**	***f***	**Percent**
Strongly Agree	32	37.21	23	46.94	54	41.22	17	27.87	159	68.83	23	46.94	245	54.69	63	39.62
Agree	21	24.42	2	4.08	65	49.62	3	4.92	5	2.16	2	4.08	91	20.31	7	4.40
Neither agree or disagree	10	11.63	16	32.65	2	1.53	39	63.93	51	22.08	16	32.65	63	14.06	71	44.65
Disagree	12	13.95	2	4.08	10	7.63	2	3.28	13	5.63	2	4.08	35	7.81	6	3.77
Strongly Disagree	11	12.79	6	12.24	0	0.00	0	0.00	3	1.30	6	12.24	14	3.13	12	7.55
Total eligible respondents	86	100	49	100	131	100	61	100	231	100	49	100	448	100	159	100

Noted: Target group (mud affected water source); Control group (Non mud affected)

Source: Fieldwork survey questionnaire data, 2013

The different results for the three occupational groups in the two different geographical locations above shows that the farmers whose ponds are located near the mud volcano were more focussed on communication between shrimp farmers and shrimp farmer associations, and indicate the associations were able to be effective communication agents after the mud volcano eruption.

According to the secretary of FKMT (male informant 4), the FKMT-Sidoarjo obtained some support from the central government agencies and Sidoarjo government to organize training among groups of shrimp farmers. Annually the FKMT-S conducted five training workshops, which were attended by approximately 20 to 40 people in each workshop from each subdistrict in Sidoarjo. The participants have an obligation to share the knowledge and skills gained in training to the other farmers. The training is usually conducted over four days. The benefit of mangrove trees in shrimp and fish farming activities is one of the main training topics.

Male informant 4 also mentioned that the mentors who were running the workshop and training had the most experience in cultivating shrimp and fish and were well known as successful farmers. The mentors shared the success story of their business and their innovations. Peer education that includes practical knowledge that is easily applied is the key to the success of this training program.

Underlying the information discussed in the preceeding paragraph, the secretary of FKMT-Sidoarjo and the chair of UPP (*Unit Pengembangan Pelayanan* - The Services Development Unit) revealed that the communication effort that developed among the farmer and the farmers' association are still conducted regularly. These regular meetings are conducted and organised by farmers' associations. At these meetings, they share not only the problems faced, but also share their experience in solving the problems. In addition, shrimp farmers' associations become a bridge between the farmer with government and/or between farmers and the buyers. Overall, based on the description above, the research group has the opinion that the farmers' association supports and assists shrimp farmers.

However, the view of the secretary of FKMT was not shared by male informant 2 who regarded communication between shrimp farmers and the association to be

ineffective. First, FKMT (*Forum Komunikasi Masyarakat Tambak* - The Communication Forum of Pond Owners) claimed a coordinator role for aquaculture farmers' associations, but the FKMT committee consisted of a chairperson (the elected Sidoarjo Regent) and a secretary. Second, the one and the only program of FKMT was facilitating the Sidoarjo government program in maintaining the rivers and irrigation channels in the pond areas.

The contradictory information gathered shows that there is an information gap between shrimp associations and their members. According to male informant 2, the friction among members occurred after the organic certification process was initiated. On one hand, two key informants assumed that the certificate would be named by the initiating partner of certification which is the Ali Ridho Group, but the certificate for the Sidoarjo shrimp farmers was organised by PT ATJ Indonesia (KPTOS). The disagreement and misperception occurred several times due to the changes in agreements between PT ATINA and shrimp associations in supplying organic shrimp (see the changes between Chart 7.1 and Chart 7.2).

The friction occurs among shrimp farmers' associations and their members relate to their agreement with PT ATINA because the committee of shrimp associations didn't sufficiently accommodate and facilitate the ideas and needs of their members.

7.3. The response of shrimp farmers to government involvement

Government programs are also an important part of the transforming structures and processes. Respondents indicated that the local government (district government-*Kabupaten*) and the village head officers were the main information channels for government policies and development programs. Furthermore, the provincial and district governments also provided support, such as larvae testing, stocking schedules, or financial assistance for settlement and flooding recovery.

Several programs conducted by the government address physical assets. These include maintenance of the river, irrigation and the development of fisheries infrastructure. The response of the government to the mud volcano eruption in Porong occurred through a number of different channels, but was largely driven by ministerial and presidential decrees and regulations. Two ministerial decrees, three

presidential decrees, and six presidential regulations regarding the Porong mud volcano disaster were formulated since 2006. These policies concerned the 600 hectares affected and focused on damming and discharging the mud, with the exception of the last presidential regulation (No 21 2017) that dissolved the Sidoarjo Mud Disaster Mitigation Agency. After the dismissal of the Sidoarjo Mud Disaster Mitigation Agency, the mitigation and recovery program fell under the Ministry of Public Works. The list of central government's decrees and regulations for setting up mitigation policies for the Porong mud volcano disaster are listed in **Appendix *2***

The provincial and district government established a special committee to tackle the negative impact of the mud volcano in Porong. The Sidoarjo government implemented the recommendations of the special committee through the revision of the Sidoarjo district spatial plan and provided a special budget allocation to support the community who were affected by the mud volcano in Porong.

Specifically, the Sidoarjo government employed the annual report of regional environmental status for monitoring the effect of the mud volcano on the environment (Badan Lingkungan Hidup Kabupaten Sidoarjo, 2011). This environmental annual report has been published every year since 2011, focusing on five broad issues in Sidoarjo: the mud volcano, river pollution, reducing farming area, and the use of coastal and marine resources.

Another instrument that was utilised by the Sidoarjo government was the Strategic Environment Assessment (SEA) (*Kajian Lingkungan Hidup Strategies*-KLHS). Badan Lingkungan Hidup Kabupaten Sidoarjo (2011) through the KLHS document, seven issues become a priority of the government. These were i) the Porong mud volcano, ii) the impact of environmental activities, iii) the impact of agricultural, fishery farms, and household waste, iv) the hygiene and health aspects of small and medium enterprise products, v) the flood intensity and coverage area, drought impacts, and or fire/damage to mangrove forests, vi) the availability of open green space and a reduction in land conversion, and vii) energy needs. This document provides guidance for formulating policies, plans, and programs based on sustainable development principles.

The Sidoarjo government's role in the development of the shrimp industry is outlined in the Sidoarjo government strategic plan. Fisheries and marine issues are the priority of the Sidoarjo government strategic plan document, which can be found in the Sidoarjo's RPJMD (*Rancangan Pembangunan Jangka Menengah Daerah* - the long-term development plan of the local government) (Bapekab Sidoarjo, 2010).

More detailed information about the government's role in providing support to the fisheries industry is in the *Rencana Strategis Dinas Kelautan dan Perikanan Kabupaten Sidoarjo* 2011-2015 (The 2011-2015 Strategic Plan Documents of Sidoarjo Marine and Fisheries Department). The Sidoarjo Marine and Fisheries Department divided their strategic plan into fourteen programs. A summary of the fourteen programs is in Table 7.2.

Optimization of the aquaculture facilities and infrastructure was a priority of the Sidoarjo government in 2011-2015. In 2011 it allocated Rp4,471,771,800.00 (AU$ 44,717.00) and Rp68,730,416,187.00 (AU$ 687,304.00) was allocated for the entire 2011-2015 period. The second biggest budget allocation was development of aquaculture, which in 2011 was Rp798,000,000.00 (AU$ 79,800.00).

Table 7.2 Sidoarjo Government budget allocation in Marine and Fisheries Sector 2011-2015 in Rupiah

	The priority programs	2011	2012	2013	2014	2015
1	Administrative Services office	55,013,700.00	611,281,000.00	672,409,100.00	739,650,010.00	813,615,011.00
2	The improvement of apparatus facility and infrastructure	7,231,500.00	750,000,000.00	450,000,000.00	470,000,000.00	520,000,000.00
3	The apparatus discipline improvement programs	8,250,000.00	10,000,000.00	11,500,000.00	13,000,000.00	14,500,000.00
4	Human Resources Capacity Building programs	76,225,000.00	150,000,000.00	160,000,000.00	170,000,000.00	180,000,000.00
5	Increase the reporting mechanism in finance and performance achievements	82,600,000.00	88,000,000.00	96,800,000.00	106,480,000.00	117,128,000.00
6	Environmental tourism development and other services in the area of marine conservation areas and forests	105,350,000.00	1,815,132,500.00	236,645,750.00	26,310,325.00	286,341,358.00
7	Development of aquaculture	798,000,000.00	2,030,000,000.00	1,218,000,000.00	1,064,800,000.00	1,171,280,000.00
8	Optimization of the facilities and infrastructure of aquaculture	4,471,771,800.00	5,093,697,400.00	5,603,067,140.00	6,163,373,854.00	6,779,711,239.00
9	Development of catchment fisheries sector	200,000,000.00	825,000,000.00	907,500,000.00	398,250,000.00	1,098,075,000.00
10	Optimizing the management and marketing of fish product	15,778,800,000.00	478,000,000.00	459,800,000.00	505,780,000.00	556,358,000.00

Table 7.2 (cont'd) Sidoarjo Government budget allocation in Marine and Fisheries Sector 2011-2015 in Rupiah- Continued.

No	The priority programs	2011	2012	2013	2014	2015
11	Development data and information systems for marine and fisheries	142,525,000.00	165,000,000.00	181,500,000.00	199,650,000.00	219,615,000.00
12	Protection and conservation of marine resources and fisheries	266,843,000.00	300,000,000.00	350,000,000.00	370,000,000.00	390,000,000.00
13	Protection and preservation of coastal areas	155,000,000.00	225,500,000.00	248,050,000.00	272,855,000.00	300,140,500.00
14	Development management of ponds and aquaculture	69,010,000.00	100,000,000.00	105,000,000.00	110,000,000.00	115,000,000.00
Total budget of marine and fisheries		22,216,620,000.00	12,641,610,900.00	10,700,271,990.00	10,610,149,189.00	12,561,764,108.00
Total spending of Sidoarjo budget		1,823,869,841,572.00	2,189,900,721,374	2,581,879,644,884.10	2,825,727,986,566	3,690,881,215,675.00

Source: The Department of Marine and Fisheries of Kabupaten Sidoarjo (2010)

The third biggest budget allocation was for the development of the catchment fisheries sector, which in 2011 was allocated around Rp200,000,000.00 (AU$ 20,000.00) and was increased for two years, except in 2014 when around Rp398,250,000.00, (AU$ 39,825) was allocated. This was increased to Rp1,098,075,000.00 (AU$ 109,807) in 2015.

Whereas optimizing the management and marketing of fish production programs[97] has reduced the budget from year to year. In 2011 this program budgeted around Rp15,778,800,000.00, (AU$ 1,577,880.00) but in 2012 it was Rp478,000,000.00 (AU$ 40,780.00) and remained around that level until 2015. The larger funding amounts in 2011 were for the development of a fish market on the Sidoarjo eastern ring road.

To investigate the perspectives of shrimp farmers, including owners, supervisors and pond workers, on government efforts to reduce the effects of the mud volcano eruption in Porong, participants were asked: "Have the enterprises that you own/where you work required government assistance?" Table 7.3 documents the results.

The target research group shows that 77% strongly agreed and 20% agreed that government assistance was required. There were just 1 percent who were neutral and just over 2 percent disagreed (0.46 percent strongly) with the proposition. A high proportion of the workers, (97 percent), supervisors (96 percent) and owners (96 percent) stated that they required government assistance to minimise the negative effects of the mud volcano. The control research group demonstrated similar percentages.

[97] One part of the five environmental sections of a broader remit of *Kabupaten* Sidoarjo

Table 7.3 Shrimp farmers' perspective about the government role

Your farmers' association had more frequent communication with government officers after the mud volcano.	**Owners**				**Supervisors**				**Workers**				**Total**			
	Target group		***Control group***		**Target group**		***Control group***		**Target group**		***Control group***		**Target group**		***Control group***	
	f	**Percent**	***f***	**Percent**	***F***	**Percent**	***f***	**Percent**	***F***	**Percent**	***f***	**Percent**	***f***	**Percent**	***f***	**Percent**
Strongly Agree	111	82.22	109	78.42	169	88.02	170	86.73	224	68.29	220	66.67	504	76.95	499	75.04
Agree	18	13.33	20	14.39	19	9.90	18	9.18	96	29.27	100	30.30	133	20.31	138	20.75
Neither agree or disagree	3	2.22	5	3.60	2	1.04	3	1.53	2	0.61	3	0.91	7	1.07	11	1.65
Disagree	1	0.74	3	2.16	1	0.52	1	0.51	6	1.83	7	2.12	8	1.22	11	1.65
Strongly Disagree	2	1.48	2	1.44	1	0.52	4	2.04	0	0.00	0	0.00	3	0.46	6	0.90
Total eligible respondents	135	100	139	100	192	100	196	100	328	100	330	100	655	100	665	100

Noted: Target group (mud affected water source); Control group (Non mud affected). Source: Fieldwork survey questionnaire data, 2013

The need for government involvement was not merely to reduce the negative impact of the mud volcano, but also for other purposes such as maintenance of access to the fish auction market or upgrading and maintenance of the irrigation infrastructures annually.

In order to understand the communication intensity among the shrimp farm owners and government representatives, I asked shrimp farmers about their communications with the village/sub-district/district/provincial officials after the mud volcano. Table 7.4 summarises the results.

In a comparison analysis between the target group and control group, Table 7.5 shows that the target group was more aware of the urgency of effective communication with government officials compared to the control group. The data shows there are around 12 percent who agree and almost 6 percent who strongly agreed that their communication with the government officer needed to be increased,[98] whereas in the control group there were slightly more than 8 percent who agreed and 2 percent strongly agreed with the proposition.

These data shows that the shrimp farmers whose ponds were located near to the polluted river expected more intensive communication with the government officers due to their greater vulnerability in having access to clean river water for their ponds.

In-depth interviews revealed shrimp farmers' frustration towards the transparency of local government bureaucratic procedures. Male informant 3 stated that the farmers who received assistance from the government generally had close relationships with members of the local parliament or other local authorities. This information parallels the fact that each parliament member has an autonomous budget allocation to be spent on their constituents or their voters.

[98] The degree of involvement includes the farmers' involvement in development planning and in the local parliament public hearings.

The result of in depth interviews [99]also supports Table 7.4 where the majority (53 percent) of the research group gave a neutral response while only 10.37 percent agreed and more than 4 percent strongly agreed they had adequate communications with government officials to solve pollution problems caused by the mud flow. It suggests that surveyed shrimp farmers did not have a strong demand for improved communications with relevant government officials, especially with the local government agencies, such as the Department of Fisheries and Marine at the district level.

Table 7.4 The communication intensity between shrimp farm owner and government officials since the mud volcano

The shrimp farm owner and government official's communication about pollution increased after the mud volcano.	**Targeted group**		**Control group**		**Total**	
	F	**Percent**	***F***	**Percent**	***F***	**Percent**
Strongly Agree	5	5.81	1	2.04	6	4.44
Agree	10	11.63	4	8.16	14	10.37
Neither agree or disagree	47	54.65	25	51.02	72	53.33
Disagree	16	18.6	16	32.65	32	23.7
Strongly Disagree	8	9.3	3	6.12	11	8.15
Total eligible respondents	86	100	49	100	135	100

Noted: Target group (mud affected water source); Control group (Non mud affected)

Source: Fieldwork survey questionnaire data, 2013

In contrast, the secretary of the Sidoarjo Government stated that the Sidoarjo government gave adequate attention to shrimp farmer empowerment, especially related to minimizing the effects of the mud volcano (male informant 10). He also gave evidence using the infrastructure program for maintaining the irrigation channel

[99] Male informants 2, 3, 5, and 7

used in the aquaculture area in Sidoarjo. He also claimed that the Sidoarjo Marine and Fishery Department had a regular program that educates the farmers to conduct and manage their ponds. Regarding the certification organized by PT ATINA, he stated that the government regulated and supervised all activities of the exporters and helped to guarantee the farmers' rights and avoid farmers being exploited by foreign shrimp export companies.

The statement of the Sidoarjo Secretary was in line with the program arranged and managed by the Sidoarjo Marine and Fisheries Department. Two priority programs have been set up. First is the physical development program known as *Tambak* (pond) irrigation channel rehabilitation and the pond deepening program, maintenance of water gates, and increasing the quality of transportation infrastructure. The second priority program is non-physical development programs, such as increasing environmental quality through farmer education programs (Marine and Fishery Department of Sidoarjo, 2010, Strategic Management Plan 2011-2015).

7.4. Market access

At harvest time, shrimp farmers have three marketing choices: sell their crop to the *pengepul*[100], sell their crop directly to the factory (exporters) or sell their crop at the nearest market. Most shrimp farmers interviewed sell their crop to the *pengepul*. The reason why they sell cheaply to the *pengepul* compared to the other two options is that they are paid directly, and the *pengepul* provides the packing and transportation from the ponds. Selling to the factory or exporter takes around 1-2 weeks to obtain payment. The agent or *pengepul* then sells the shrimp to the factory or exporter across 1-2 weeks of payments. The survey found that 92.86 percent of Sidoarjo shrimp farmers research group prefer to use cash payment for their transaction.

Some farmers preferred to sell their crops to the TPI (TPI-*Tempat Pelelangan Ikan*-Fish Auction Market) but their numbers were relatively small. Male informant 8, who is a fish market trader, mentioned that the quantity of the pond product sold in the fish market was no more than 100 kg on one day's trading. Furthermore, he

[100] A middleman, most of them are small-medium shrimp buyers.

stated that the products were of lower quality – suitable for domestic consumption rather than export.

The market opens in the early morning when fishers return from their fishing grounds. Sidoarjo has two special markets for fisheries located in Sedati and Sidoarjo. In addition, Sidoarjo has around 18 traditional markets that sell fish and aquaculture products. Sidoarjo also has around 313 modern markets, 2 supermarkets and 9 malls (BPS Sidoarjo, 2015).

Based on field observations, the aquaculture industries in Sidoarjo serviced local, regional, national and international markets (see Table 7.5. Of these markets, the most important were the local, Sidoarjo District, and export markets. This data is analogous to the grey data that was depicted in the section 3.2.2

Table 7.5 Shrimp pond owner views on the importance of different market outlets

The perspective of the shrimp farm owner to market	Local Village market		Inner city market		Other cities in East Java		Market outside East Java		Overseas market	
	F	**Percent**	***f***	**Percent**	***f***	**Percent**	***F***	**Percent**	***f***	**Percent**
Most important	30	22.22	8.0	5.93	1	0.74		0.00	62	46.27
Important	80	59.26	52.0	38.52	2	1.48	1	0.74	3	2.24
Less important	24	17.78	71.0	52.59	35	25.93	2	1.48	4	2.99
Neither important or not	1	0.74	4.0	2.96	93	68.89	34	25.19	32	23.88
Nearly not important	0	0.00	0.0	0.00	4	2.96	98	72.59	33	24.63
Total eligible respondents	135	97.12	135	97.12	135	97.12	135	97.12	134	96.40

Source: Fieldwork survey questionnaire data, 2013

A detailed investigation (Table 7.6) revealed that almost 54% of the shrimp pond owners stated that more than 50% of their pond products were for the export market followed by almost 32% of respondents who stated they sold between 1 and 10 percent of their product to overseas consumers.

Table 7.6 Export market proportion

Export market share	***f***	**Percent**
1-10 percent	39	31.71
11-20 percent	4	3.25
21-30 percent	2	1.63
31-40 percent	1	0.81
41-50 percent	11	8.94
>50 percent	66	53.66
Total eligible respondents	123	88.49

Source: Fieldwork survey questionnaire data, 2013

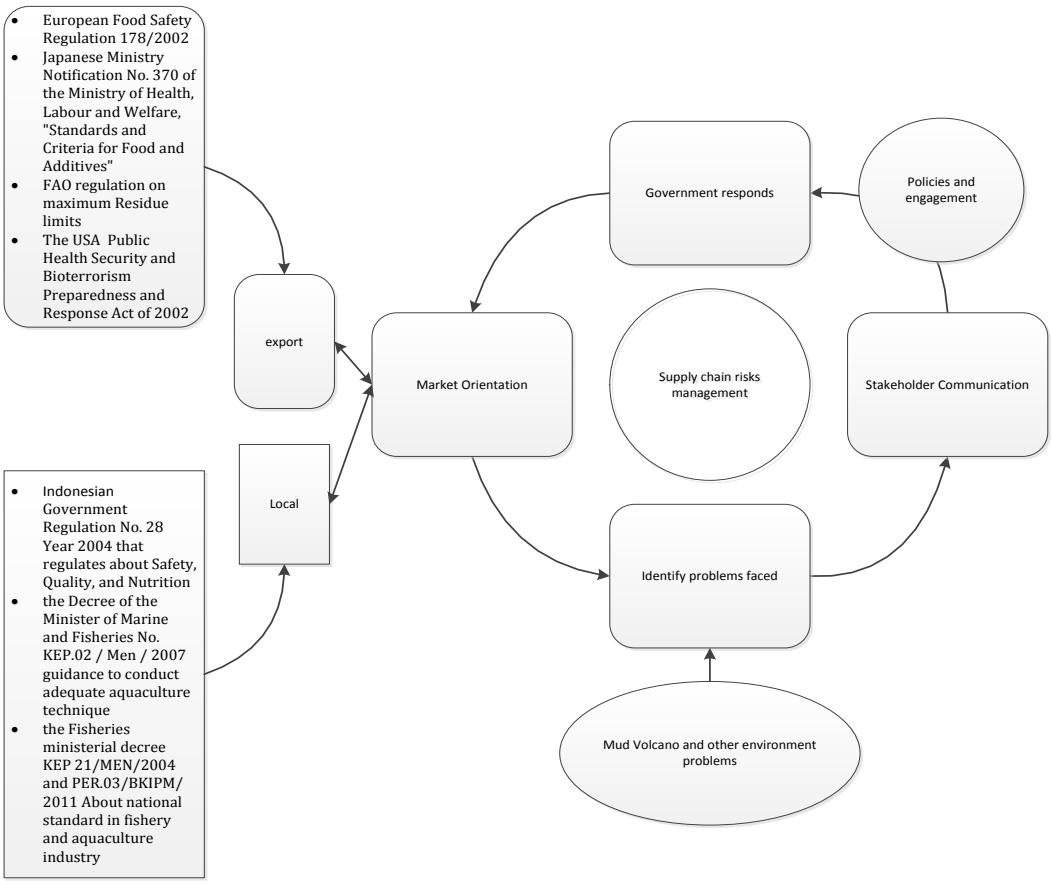
7.5. Discussion

The mud volcano disaster in Porong impacted on aquaculture industry communities of Sidoarjo through its effects on the structures and processes through which shrimp farmers were able to implement their livelihood strategies. According to Robbins (2012, p. 91), observing human adaptation strategies in a changing environment requires multiple data sources and approaches. Bornstein (2007) argues that changes in community values and perspectives are the beginning of social changes in the community, and those values and perspectives are strongly influenced by the ways in which people interact with transforming structures and processes, and each other, to overcome environmental and other problems. Every individual or community may react differently to the changes and such reaction is shaped by their past experiences.

In the case of the mud volcano in Porong, changes in supply chains elicited community reactions that were influenced by the social capital of the shrimp farmers, especially their past experience when most shrimp farmers were unsuccessful in using intensive aquaculture methods and were affected by the broader socio-economic environment of buyers and other groups. Having limited access to clean water or proper infrastructure for distribution changes the shrimp farmer's livelihood, as does opportunities to access international markets if they meet regulatory standards. The shrimp farmers and other groups each had their own aims and purposes in keeping their livelihoods sustained. Each group had to communicate, negotiate and manage their interests with limited resources.

Chart 7.3 portrays the Grant (2001) postulate in the existing case of Sidoarjo shrimp industry that deals with the mud volcano.

Chart 7.3 Factors that influence the shrimp farmers' livelihood strategies



Sources: Field observation, 2013

Chart 7.3 depicts the process of shrimp farmer communities' negotiating strategies for neighbourhood development needs in order to reconstruct the shrimp supply chains, in measuring their market, and sustaining their livelihood.

The first negotiating strategy the farmers used was to utilise the structures provided by associations to assist them to learn and solve problems. The relationship between shrimp farmer and the shrimp farmers' association showed the effectiveness of communication between the shrimp farmers and the shrimp farmers' association after the mud flow in that farmers had regular communication with the association through annual meetings.

The farmer associations were considered important for five reasons. First as an agricultural development administrative support system. Secondly as a communication mediator between the farmers and government. These two reasons could be seen from the role of FKMT that bridges the aquaculture farmer interest and the government program, and assists government officers to register and gather information from the farmers at the grass root level. Third, the farmer associations were a symbol of the farmers' involvement in development through its role as one of the government partners in *Musrenbang.*[101] Fourth, the farmer associations were a collective economic actor. Section 3.2.2 indicated that Sidoarjo produces shrimp valued at Rp108,710 billion (A$108.7 million). This showed that shrimp farmers as a group contribute significantly to the regional economy. Finally, the farmer associations functioned as the farmers' political representative in the form of a principal-agent relationship in which one entity legally appoints another party to act on his or her behalf (Allen, 1985; Carruthers, 1996; Helm & Wirl, 2014; Shavell, 1979). The associations were able to put pressure on the state to implement programs.

[101] *Musrenbang* is a mechanism that guides local governments in Indonesia in formulating development plans. This mechanism also functions as a guide in the planning and the evaluation of regional development (the Minister of Home Affairs instruction letter (decree) number 50/987/SJ 2003)

The second negotiating strategy is communication development. The farmers' ability to develop communication with their aquaculture counterparts to seek support can be categorised as bridging ability or an ability to generate access to outside resources (developing networks). In other words, having good relationships with other organisations is part of an effort to build social capital. In doing so farmers developed vertical and horizontal relationships. Vertical relationships were developed with a hierarchical system, in this case with government, while horizontal relationships were built with other community organizations on matters such as markets and their demands.

Chart 7.1 and Chart 7.2 show the bridging networks of Sidoarjo shrimp farmers in two different time layers. The two charts demonstrate the role of buyers in absorbing and buying the shrimp farmers' products.

The relationships among shrimp pond owners with warehouses, middlemen (*pengepul*), and farmer cooperatives[102] demonstrates connectivity of the shrimp farmers in bridging and bonding their horizontal relations. The relationship pattern between shrimp farmers and their buyers took two forms.

First, the cooperation model conducted by shrimp pond owners and PT ATINA from 2002-2008, when the Sidoarjo shrimp farmers held an organic certification from IFOAM on behalf KPTOS and PT ATINA was a principal-agent model. The shrimp association and PT ATINA shaped an environmentally friendly shrimp cultivating process. This model implies adopting Kurt Lewin's theory about a three-stage model of change that has come to be known as the unfreezing-change-refreeze model that requires prior learning to be rejected and replaced (Schein, 1996). The process of dismantling thinking develops through presenting provocative issues or by using charismatic people or, people who have a willingness to create a better society. In this instance, PT ATINA was able to exhibit an environmentally friendly shrimp cultivating process, demonstrating to the wider shrimp farmer community in Sidoarjo a sustainable shrimp farming process.

[102] Examples of cooperatives are ARG groups and Eco-shrimp with PT ATINA

Second, the relations between the warehouse and cooperative was similar to the patron-client model. Warehouses and co-op groups provide the roles of a financial provider institution and a pond's raw material provider. The financial and other support provided by the warehouse and cooperative was eventually paid for at harvest time. As a consequence, having that financial support at harvest time, the shrimp farmer has an obligation to sell their crop to the warehouse or cooperative.

The relationship between shrimp farmers as a community and the government, demonstrated shrimp farm owners' activity in bridging their vertical relationship. Effective relationship between the government and the affected victims would reduce social fragmentation, social isolation and develop public trust through government policies. The degree of government involvement in caring for community needs shape collective social interest (Hobbes, 1997)

The government and shrimp farmers' relationship could be seen from the rules and regulations that have been set up by the government in order to support shrimp farmers in solving their problems. Heywood (2015) stated that government has a mandate to formulate policies, therefore they are obligated to support the community's development at public expense. The governments' efforts in influencing and controlling the negative effect of the mud could be seen from the two ministerial decrees, three presidential decrees, and six presidential regulations regarding the Porong mud volcano disaster (see appendix 2). These regulations were aimed at mitigating the mud volcano in its immediate geographical vicinity, while mitigation in aquaculture over a larger geographical area was mostly handled in the annual program of the Sidoarjo Marine and Fisheries Department. The support of the Sidoarjo government for the aquaculture industry[103] is demonstrated through the Sidoarjo's RPJMD (*Rancangan Pembangunan Jangka Menengah Daerah* - the long-term development plan of the local government)[104].

[103] Aquaculture industry is one form of the dialectic of the economic need and environment sustainability

[104] The budget allocation of Sidoarjo government in marine and fisheries sector 2001-2015 can be seen in Appendix *3*

7.6. Conclusion

In order to seek an answer as to how the network and transformation process occurs, I conducted field surveys, and interviewed Sidoarjo shrimp farmers in two locations impacted severly, and impacted minimally, by pollution from the mud volcano. The most important aspect of the network and transformation processes are illustrated in the two diagrams of supply-chains in 2006 and 2009. By addressing the dynamics of the supply-chain of Sidoarjo shrimp industry before and after the mud volcano, differences in farmer reactions to the threats and hazards that disturb their aquaculture business can be seen to be important factors shaping resource access and livelihood capability. This indicates how supply chains are important transformative structures that relate to livelihood strategies. The dynamic response of the aquaculture community was demonstrated in the survey that investigated the degree of effectiveness of communication between shrimp farmers and shrimp farmers' associations. The percentages of the research group, both in the target location and the control location are similar. The owners were more aware than supervisors and workers due to their need to anticipate changes in their supply chains.

The farmers whose ponds are located near the mud volcano, the target group, were more supportive of the association's communications. This is because they felt more vulnerable compared to the farmer whose ponds are located far from the mud. Not only that, due to the need for more support, they expected that by having more efficient communication their difficulties that were caused by the mud volcano eruption could be helped and assisted.

Government programs were viewed as important and connected to the actions of the shrimp farmer associations. There was little importance placed on increased government communications because the shrimp farmers were considered too removed from the mud volcano to access relief payments, and shrimp farmer associations were effectively communicating with the government with regards to industry programs.

The result of the survey in two geographical locations shows many factors influence the dynamic of the shrimp industry supply chain. However, the main factor that

influences the shrimp industry supply chain is the standards set by different markets. Aiming to fulfil the market's criteria and standards, the shrimp farmer community actively developed communication among their associations and the government in order to support aquaculture production, especially when this sector is facing threat and hazards such the occurrence of the mud volcano. The next chapter will conclude and summarise the research.

CHAPTER 8. CONCLUSION AND FUTURE RESEARCH

Chapters one and three identified two events that significantly affected Sidoarjo shrimp sector production. The first was an enormous shrimp mortality event in 1994. The shrimp mortality cases were spread across an area of 9000 hectares and affected around 60 percent of the shrimp ponds in Sidoarjo (Siregar, 2007). This production failure began occurring in 1992 but was most pronounced in 1994. Some experts contended the mortality event occurred because of mismanagement in shrimp culture and high levels of pollution. In-depth interviews revealed those crop failures were caused by reducing the carrying capacity of ponds because of intensive cultivation production that tends to ignore land quality. Declining pond and land quality were the result of inefficiency in feeding methods and the inappropriate use of antibiotics (Alie Poernomo, 1989). P. Bhattacharya and Ninan (2011) show that intensive shrimp culture experienced an inefficiency in feeding of up to 25 percent. The feed that was not consumed settled to the bottom of the pond. This situation worsened due to mangrove deforestation and water pollution. As a result, the quality of shrimp farmers' land declined.

The second event is the Porong mud volcano that began erupting in May 2006. Policy decisions taken by authorities to divert the mud to the Porong River and Kalitengah River polluted aquaculture properties reliant on these waterways and adjacent parts of Madura Strait.

8.1. Revisiting the research question

This research has used the SLF to explore how the behaviour of shrimp farmers changed in response to actual and potential negative impacts of the Porong mud volcano. Firstly, it examined the socioeconomic impact of the mud volcano on shrimp fisheries production. Secondly, it analysed how Sidoarjo shrimp farmers responded to the effects of the mud volcano on shrimp production.

8.1.1. Research Finding One

The 2007 Porong mud volcano has significantly impacted upon the economic activities of East Java. It contributed to a reduction of about 200,000-300,000

vehicles passing through the Porong highway. In addition, it has also contributed to a loss of domestic income of Rp170 trillion (A$170 million) in the region during 2007-2008 alone (Yahya, 2008). Summarizing the grey literature reviewed in chapters one and three, the existence of the mud volcano disrupted the social and economic life of residents and businesses, contributing to a crop failure affecting 800 hectares of paddy fields, and has destroyed important infrastructure in East Java.

In the aquaculture sector, fish and shrimp production in Sidoarjo District declined between 2007 and 2009 (DKP Kabupaten Sidoarjo, 2011) with the largest decrease in fish production of 26 percent alone in Porong subdistrict. Overall Sidoarjo District experienced a reduction of 24.81 percent in fisheries production in 2008.

This research found that the mud volcano increased the frequency and the quality of communication among shrimp farmers. This is because the shrimp farmers faced a similar problem of increasing water pollution due to the mud volcano eruption and sought a solution for minimizing the negative impact of the mud by innovation and inventing a technique for aquaculture.

8.1.2. Research Finding Two

This thesis' strongest contribution is its findings on the socioeconomic impact of the Porong mud volcano. This thesis has examined three components. The first component is the financial and social aspects that relate to the economic role of the shrimp industry in regional economies. The role of the shrimp economy can be seen from farmers' income. The majority of survey respondents reported an income at or above the Sidoarjo minimum standard wage. Furthermore, the majority of the research group can be categorised as small-medium farmers based on two indicators: the value of the pond; and the size of the pond.

The second component is the access of the Sidoarjo shrimp farmers to the five[105] livelihood assets. This thesis compared farmers in two locations: a group in locations affected by the mud volcano, and a second group in locations that were only

[105] Human, environmental, physical, financial, and social assets.

minimally affected. In terms of livelihood strategies, there is almost no difference in access to physical and environmental assets between groups in the two differently defined geographical locations, while there are differences in social, human and financial assets. This thesis has demonstrated that farmers who owned a pond located on a river or water supply affected by the mud volcano have acquired greater human and social assets due to their response to the mud volcano. There has been more frequent information sharing and communication strategies amongst shrimp farmer associations, and, to a lesser degree, through government programs. However, affected shrimp farmers have less access to financial assets. It is more difficult now for them to access loans from banks. The lack of a large difference in environmental assets is due to the effective response of affected shrimp farmers.

The last component is the resilience and transformation process of the shrimp industry supply chain in two different timeframes: before and after the mud volcano. Before the mud volcano, shrimp farmers responded to the massive death of shrimp due to intensive cultivation by utilising traditional farming techniques (in particular their use of mangroves) as well as developing new techniques, such as using local probiotics and avoiding hormones that accelerated shrimp growth. After the mud volcano, further innovations included the meandering irrigation system and the use of biological indicators of water quality. They also responded through their supply chains. Chart 7.1 and Chart 7.2 demonstrate how shrimp farmer associations were able to retain access to international markets.

8.1.3. Research Finding Three

In response to increased river pollution, individual Sidoarjo shrimp farmers have reacted in diverse ways.[106] The first response is that the farmers have more awareness of environmental phenomena by adopting silvofishery system that

[106] This research also found that the farmers sold their ponds and changed their business to another sector. But the number of farmers who sold and changed their business was not big; much of their reason for selling was because the pond was their parental inheritance and they had to split and share with their sibling. The other reason why the farmer sold their pond was because the site planning and development purpose of the area where the pond was located had changed from an agriculture area to become residential or an industrial area. However, as this research is focusing to the impact of the mud volcano made upon ongoing shrimp farmers' activities, this finding is not described in detail.

integrated shrimp culture and mangrove conservation, and developed a cultivation method that utilises living vegetation as a support system. This response demonstrates changes in human and environmental assets. The second response is that farmers have a higher awareness of food safety issues, which in Sidoarjo is demonstrated through the use of organic or biological pesticides and organic or biological fertiliser. The third response is that farmers change their marketable commodity, from shrimp to cultivating to another aquaculture commodity (fish, crab) that can adapt to the harsh or polluted environment. This response demonstrates the farmers' modifying practices to market needs for safe and high quality shrimp products.

Based on this finding, the thesis demonstrates that farmer innovation[107] was generated from long term experiments and experiences rather than short term reactions. The majority of the Sidoarjo shrimp farmers are categorised as practitioners of traditional (extensive) aquaculture. Traditional aquacultures develop through trial-and-error learnt in fishing and their interaction with the immediate environment both before and after the mud volcano.

Through the trial and error process and some involvement from off-site parties, this research found four innovations were particularly important for maintaining the quality of shrimp ponds. The first is applying traditional and/or organic cultivation methods that use natural solutions such as non-use of antibiotic and hormonal growth treatments. The second action is manipulating the use of living vegetation for filtering river water. The third main action involves ways of ensuring the entry of oxygen into shrimp ponds. The fourth action is the application of traditional medicines for shrimp.

8.2. Contribution of the research

The main conceptual contribution of the research is in the area of livelihood, resilience and commons literature. Usually, the Sustainable Livelihoods Framework (SLF) has been considered as a tool to primarily address poverty alleviation amongst

[107] In some terms I use 'good practices' in explaining the shrimp farmer innovation

marginalised populations in the developing world (DFID, 1999; Morse, 2013). However this research identified the potential for the SLF to be adapted to the task of investigating the impact of a disaster by examining local livelihood strengths in supporting a resilience process in re-investment strategies to expand livelihood assets. The SLF can provide windows into understanding how local shrimp farmers have negotiated risks in response to a major environmental hazard while operating within the context of a local and globalised aquaculture industry.

However, it was challenging to measure and assess resilience in a socio-economy-ecological framework. To address this gap in the literature, the present research developed ways to assess the level of resilience. My research generated nuanced, locally focused, and locally meaningful understandings of the vulnerabilities and resilience of individuals, households and communities in various development contexts. This research combined the Sustainable Livelihood Framework and Supply Chain Risk Management in identifying vulnerabilities and resilience of Sidoarjo shrimp farmers in facing environment changes that caused the Porong mud volcano.

By combining the SLF and Supply Chain Risk Management it is possible to have precise mapping of the actors involved/affected and to examine the past events as a formula which can be used to create an early warning system in anticipation of the risk that might disturb the community livelihood and how to quickly and effectively mitigate those risk. In addition, the Supply Chain Risk Management is strengthening the use of SLF in identifying community resilience process.

As described by Chambers and Conway (1992); DFID (1999); Ludi and Slater (2008); Scoones (1998, 2009) Scoones (2015a), the SLF is able to collect and categorise information for assisting and providing input into the policy-making processes. Similarly, Jüttner et al. (2003); Ritchie and Brindley (2007); O. Tang et al. (2012) refer to Supply-Chain Risk Management's ability to assist the decision-makers make the right decisions to avoid failure and losses. According to Cumming et al. (2005) there are four elements that need to be considered in resilience processes: (1) the combination of human and non-human factors, (2) the interaction and relation of system components, (3) sources of innovation that generate change

and novelty, and (4) sources of continuity that maintain a system's cohesion through space and time.

By identifying the livelihood assets and interactions depicted in chapters 5 and 6, understanding the motivation and stimulant of the changes depicted in chapters 1 and 3, recording the abilities of shrimp farmers' communities in anticipating the environment changes are depicted in chapter 7, the thesis identifies and provides an analytical description of what has happened to the livelihoods of Sidoarjo shrimp farmers. Identifying and measuring these four elements contributed to an understanding of the ongoing evolution of the livelihood systems and measuring resilience changes in the system over time.

8.2.1. Methodological contributions

The Sustainable Livelihood Framework (Chambers & Conway, 1992; DFID, 1999; Ludi & Slater, 2008; Scoones, 1998, 2009, 2015a) and Supply-Chain Risk Management principles (Jüttner et al., 2003; Ritchie & Brindley, 2007; O. Tang et al., 2012) used in this research provided some useful tools to investigate the various aspects of livelihood systems and common management systems. The Supply-Chain Risk Management analysis strengthened the SLF's category of transforming processes.

8.2.2. Policy Contributions

The primary policy contribution of this thesis concerns commons management and resilience building in livelihood systems. Livelihood resilience can be developed at different levels and the possibility of success or failure of livelihood systems can be assessed prior to decision making.

The SLF provides opportunities for the state to strategically assist affected shrimp farmers access livelihood assets. The intervention requires flexible planning. These interventions can be informed by local needs and priorities, and take into consideration all user groups.

The values and cultures that are embedded in shrimp farming societies are already generating solutions to environmental problems. Identifying and sharing useful local knowledge (human capital) within the shrimp farming industry provides an alternative strategy and stronger awareness of local values. Future policies should strengthen interrelationships between fellow farmers and government that encourage a sense of belonging with the aim to promote sustainable and systemised relations (Collins, 2009, p. 192).

8.3. Limitation of this study and aspect of future research

The Sidoarjo shrimp industry requires further research for two reasons. First, much existing research does not consider secondary data and statistics on government sources, as I found some problems with their quality as stated in section 4.1.1. There is a need to generate reliable basic data to inform research on the Sidoarjo shrimp industry.

Second, the disciplinary boundaries made integrating approaches from different disciplines complicated. This research only portrays the Sidoarjo shrimp farmers' reaction (their knowledge and livelihoods) in facing environmental change, rather than more detailed research that investigates the systems and resource dynamics of shrimp farmers. The information gathered relied heavily on the experience of the key informants for knowledge of shrimp farmer innovations.

My background is in the discipline of economics and public policy. However, I have professional experience in community development and government program evaluation. Not only that, as a local resident of Sidoarjo (I was born and grew up there), I have privileged access to observe and understand the behaviour of the Sidoarjo shrimp community that is not granted to outside researchers. Humbly mentioning this, I tried to use this access to research issues of aquaculture policy and productivity. . Therefore, future research on shrimp farmers in Sidoarjo should concentrate on Indonesian government (local, provincial and national) policies in response to shrimp farmer innovations for wider use in aquaculture, and longitudinally investigate the degree of productivity of the ponds that use the meandering irrigation system. Both research areas are livelihood outcome research.

Finally, migration patterns of workers following the mud volcano eruption also requires further research.

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APPENDIXES:

Appendix 1 Key informants and data collected

	Key informants	**Data collected**	**Results**
1.	The Fisheries and Marine Department in Sidoarjo	The Sidoarjo Government reports on available shrimp industry data covering the study period	The shrimp production data and informal discussion about the recent issue of aquaculture in Sidoarjo
2.	The Government Mitigation Agency (BPLS)	The update of the recent data of the mud volcano	My efforts of communication attempts failed. However, I was able to gather mud volcano data from Walhi Indonesian Greenpeace) an NGO that concerning the environment
3.	WALHI	The recent update of pollution data The NGOs perspective on the mud volcano	Responses of the NGO that concerning the environment Collect other secondary data
3.	The Sidoarjo Environment Agency	The river pollution data in annual reports	Gathering several data of several rivers in Sidoarjo and informal discussion about the recent condition of Sidoarjo environment isssues including the river management and pollution
4.	Sidoarjo Planning	• The Sidoarjo Site Plan	Overall information on

	Board	• The Sidoarjo Strategic Plan • The Eastern Sidoarjo Action Plan • The South Sidoarjo Action Plan	the shrimp industry in Sidoarjo
5.	The District Secretary	The government perspective of the shrimp farmer empowerment, post the occurring mud volcano	The perspectives and the overview of the work carried out by the Secretariat
6.	The local Parliament	The legislative initiatives supporting the shrimp farmers who were affected by the mud volcano	Budget allocation for specific relief initiative
7.	Selected shrimp farmer association 1 (FKMT)	The shrimp farmers' perspective of the shrimp culture (Interview with the secretary of this association)	Responses of the FKMT as a stakeholder of the Shrimp industry
8.	PT Atina (Shrimp export company)	The buyers' perspective of the shrimp culture (Interview with the manager of the PT Atina)	Responses of the PT Atina as a stakeholder of the Shrimp industry
9.	Selected shrimp farmer association 2 (ARG)	The buyers' perspective of the shrimp culture (Interview with the manager of the Ali Ridho)	Interview with the leader of this group and failed to have further quantitative data from the factory
10.	Anonymous selected Tiger	The role model perspective of the	The informants' perspective and

	Shrimp Farmer role model	Sidoarjo shrimp culture	information about their good practices in aquaculture
11.	Anonymous selected Vanname Shrimp farmer role model	The role model perspective of the Sidoarjo shrimp culture	The informants' perspective and information about their good practices in aquaculture
12.	Anonymous selected farmer representing a diverse shrimp, milkfish, and seaweed farming methods	The diverse farmers' perspective	The informants' perspective and information about their good practices in aquaculture
13	2 anonymous selected Tiger Shrimp Farmer represent the ATJ Partner	The farmer perspectives	The informants' perspective and information about their good practices in aquaculture
14.	Anonymous- a selected fish market trader	The local buyer perspective of the Sidoarjo shrimp culture	The local trader's perspective
15	Anonymous pengepul (middleman)	The local buyer perspective of the Sidoarjo shrimp culture	The local trader's perspective
16	Anonymous pond informal worker		The informal worker perspective

Appendix *2* National government policies for mitigating the effects of the mud volcano disaster in Porong

Policies	Number [108]	Document content
Ministry of Energy and Mineral resources decree	SK Menteri ESDM No. 2231 K/73/MEN/ 2006	The establishment of investigation team for the spewing of hot mud surrounding Banjarpanji-1 well
Ministry of Public Works decree	SK Menteri PU No. 312/KPTS/M/ 2006	The establishment of mitigation team formation whose duty is to control the spewing mud
Presidential decree	Keppres No. 13 2006	The establishment the national mitigation team and determine the task and duties
Presidential decree	Keppres No. 5 2007	Determine the working period extension of the national mitigation team
Presidential regulation	Perpres No. 14 2007	The establishment of the new form of the national mitigation
Presidential regulation	Perpres No 48 2008	The amendment of Presidential decree No 14 2007
Presidential regulation	Perpres No 40 2009	The second amendment of Presidential decree No 14 2007
Presidential regulation	Perpres No 68 2011	The third amendment of Presidential decree No 14 2007
Presidential	Perpres No 37	The fourth amendment of Presidential decree No

[108] Policy codification number

regulation	2012	14 2007
Presidential decree	Keppres No 11 2015	The establishment of acceleration team for the payment of the land and building of the Sidoarjo mud flood victims in the determined area March 22 March 2007
Presidential regulation	Perpres No 21 2017	The dissolution of the Sidoarjo Mud Disaster Mitigation Agency.

Appendix *3* Sidoarjo Government budget allocation in Marine and Fisheries Sector 2011-2015 in Rupiah

	The priority programs	2011	2012	2013	2014	2015
1	Administrative Services office	55,013,700.00	611,281,000.00	672,409,100.00	739,650,010.00	813,615,011.00
2	The improvement of apparatus facility and infrastructure	7,231,500.00	750,000,000.00	450,000,000.00	470,000,000.00	520,000,000.00
3	The apparatus discipline improvement programs	8,250,000.00	10,000,000.00	11,500,000.00	13,000,000.00	14,500,000.00
4	Human Resources Capacity Building programs	76,225,000.00	150,000,000.00	160,000,000.00	170,000,000.00	180,000,000.00
5	Increase the reporting mechanism in finance and performance achievements	82,600,000.00	88,000,000.00	96,800,000.00	106,480,000.00	117,128,000.00
6	Environmental tourism development and other services in the area of marine conservation areas and forests	105,350,000.00	1,815,132,500.00	236,645,750.00	26,310,325.00	286,341,358.00
7	Development of aquaculture	798,000,000.00	2,030,000,000.00	1,218,000,000.00	1,064,800,000.00	1,171,280,000.00
8	Optimization of the facilities and infrastructure of aquaculture	4,471,771,800.00	5,093,697,400.00	5,603,067,140.00	6,163,373,854.00	6,779,711,239.00
9	Development of catchment fisheries sector	200,000,000.00	825,000,000.00	907,500,000.00	398,250,000.00	1,098,075,000.00
10	Optimizing the management and marketing of fish product	15,778,800,000.00	478,000,000.00	459,800,000.00	505,780,000.00	556,358,000.00
11	Development data and information systems for marine and fisheries	142,525,000.00	165,000,000.00	181,500,000.00	199,650,000.00	219,615,000.00
12	Protection and conservation of marine resources and fisheries	266,843,000.00	300,000,000.00	350,000,000.00	370,000,000.00	390,000,000.00
13	Protection and preservation of coastal areas	155,000,000.00	225,500,000.00	248,050,000.00	272,855,000.00	300,140,500.00
14	Development management of ponds and aquaculture	69,010,000.00	100,000,000.00	105,000,000.00	110,000,000.00	115,000,000.00
Total budged of marine and fisheries		22,216,620,000.00	12,641,610,900.00	10,700,271,990.00	10,610,149,189.00	12,561,764,108.00
Total spending of Sidoarjo budget		1,823,869,841,572.00	2,189,900,721,374	2,581,879,644,884.10	2,825,727,986,566	3,690,881,215,675.00

Source: The Department of Marine and Fisheries of Kabupaten Sidoarjo (2010)

Appendix 4 Four Type of research Questionnaire

Apakah anda berusia 18 tahun atau lebih?, Apakah anda saat ini bekerja disalah satu tambak udang yang berada disalah satu wilayah berikut ini? : Gebang, Sekardangan (Kec. Sidoarjo), Kedung Peluk (Kec. Candi), BanjarPanji, Banjar Asri, Penatar Sewu (Kec. Tanggulangin) Plumbon (Kec. Porong), Permisan, Tambak Kalisogo, Kupang, Kedung Pandan (Kec. Jabon), Sawohan (Kec. Buduran), Kalanganyar, Tambak Cemandi, Banjar Kemuning (Kec. Sedati) and Tambak Sawah (Kec. Waru)

Jika iya, kami berharap anda bersedia berpartisipasi dalam survey ini..

Survey ini berusaha menggali informasi tentang respon petani udang, pemerintah dan pihak terkait atas terjadinya bencan lumpur vulkanik di Porang pada wilayah tertentu yang menjadi target penelitian. Survey ini terfokuskan pada: tingkat kontaminasi dan gangguan yang dialami petambak udang atas munculnya Lumpur panas di Porong; dampak sosial-ekonomi dari gangguan yang muncul terhadap produksi tambak udang; metode dan tekhnik yang dilakukan oleh petambak udang dalam menyikapi potensi ancaman yang muncul; peranan pemerintah dalam dukungannya kepada petambak udang dalam menanggulangi potensi polusi; sejauh mana dukungan pemerintah terhadap usaha yang terdampak; sejauhmana innovasi yang dilakukan oleh petani udang di Sidoarjo bisa diadopsi di daerah lain di Indonesia.

Survey ini memakan waktu 60 menit. Nama dan identitas anda akan dirahasiakan dalam survey ini

Survey ini dipersiapkan oleh Achmad Room Fitrianto sebagai bagian dari penelitian yang bersangkutan untuk memperoleh gelar PhD Pada The School of Social Science and Asian Languages Curtin University, Perth. Judul PhD thesis yang diajukan adalah “The socio-economic impacts of the Porong mud flow on the shrimp fisheries sector in Sidoarjo District, East Java Province Indonesia". Penelitian ini dibawah bimbingan Prof. Dr. Bob Pokrant dan Dr. Aileen Hoath dari Curtin University.

Penelitian ini akan menyelidiki setiap dampak dari bahaya yang disebabkan manusia atau alam yang mempengaruhi kondisi sosial ekonomi dari Industri udang. Dengan menggambarkan berbagai kerentanan yang berpotensi terjadi di komunitas, penelitian ini akan membantu mengidentifikasi sumber utama kerentanan dan kelompok-kelompok lokal tertentu yang paling terpengaruh oleh mereka, dengan cara ini masyarakat akan berada dalam posisi yang lebih baik untuk menanggapi keprihatinan dengan cepat dan juga merencanakan untuk segala kemungkinan di masa depan.

Penelitian doktoral ini didukung oleh Kementerian Pendidikan dan Kebudayaan, Direktorat Pendidikan Tinggi Indonesia dibawah program beasiswa DIKTI Bench 5

Penelitian ini sudah sesuai dengan prosedur ethic dari Curtin University. Semua data yang dikumpulkan sesuai dengan pedoman penelitian perguruan tinggi untuk melindungi anonimitas masing-masing narasumber atau obyek penelitian. Setiap publikasi yang dihimpun dari survey ini akan dicantumkan sebagai informasi

Kesediaan anda untuk mengisi survey ini akan dipahami sebagai bentuk kesediaan anda dalam berpartisipasi dalam penelitian ini dan kesediaan untuk mengijinkan mengunakan informasi yang anda berikan untuk kepentingan ilmiah penelitian ini

Untuk Keterangan lebih lanjut tentang penelitian ini, tujuan penelitian anda dapat menghubungi Achmad Room Fitrianto

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No. Questionnaire :		**Tanggal :**			
No. Desa :		**No. Kecamatan :**			

Silahkan beri tanda silang atau centang salah satu pilihan jawaban berikut ini

a. **Data demografi dasar**

Bagian berikut ini akan menampilkan profil dari responden penelitian ini.

1 Apakah gender anda?

○ a. Laki Laki ○ b. Perempuan

2 Berapakah Usia anda?

○ a.18-25 ○ c. 46-65

○ b.26-45 ○ d. 66+

3 Latar pendidikan/ pendidikan tertinggi yang dicapai

○ a. SD ○ b. SMA

○ c. SMP ○ d. Perguruan Tinggi

○ e. Lainnya, Mohon jelaskan ……

……..

4 Sudah berapa lama anda bekerja di tambak ini?

○ a. Kurang dari setahun ○ c. 5-10

○ b. 1 -5 Tahun ○ d. >10 Tahun

5 Sudah berapa lama anda bekerja dengan posisi ini?

○ a. Kurang dari setahun ○ c. 5-10

○ b. 1 -5 Tahun ○ d. >10 Tahun

Data Rumah Tangga

6 Berapa anggota keluarga anda yang tinggal serumah dengan anda?

○ a.2-4 Orang ○ c.7-9 Orang

○ b.5-6 Orang ○ d. Lebih dari 10 Orang

Silahkan isi tabel berikut ini dari anggota keluarga anda tersebut

No.	Nama (inisial)	Hubungan dengan resonden	Gender		usia	Tingkat Pendidikan	Pekerjaan Saat ini
1.			L	P			1.
2.			L	P			2.
3.			L	P			3.
4.			L	P			4.
5.			L	P			5.
6.			L	P			6.

7.			L	P			7.

7. Apakah ada diantara anak anda atau anggota keluarga yang lain yang bekerja di perusahaan (tambak) yang sama dengan anda?

- ○ a. Ya, Sektor dan perusahaan yang sama
- ○ b. Ya, Tapi beda perusahaan
- ○ c. Tidak

8. Berapa perkiraan total pendapatan anda dari bekerja di tambak udang termasuk bonus dan insetiv lainnya

- ○ a. Rp 100,000-Rp 500,0000
- ○ b. Rp 500,001-Rp 1000,000
- ○ c. Rp 1,000,001-Rp 1,500,000
- ○ d. Rp 1,500,001-Rp 2,000,000
- ○ e. Rp2,000,001-Rp 2,500,000
- ○ f. Lebih dari Rp 2,500,000

9 Bagaimana cara anda di bayar/gaji?
Catatan: bisa dijawab lebih dari satu jawaban

- ○ A. Mingguan
- ○ B. Bulanan
- ○ C. Komisi, berapa persen?
- ○ D. Bagi hasil
- ○ **V. Lainnya, Mohon jelaskan ……..**

10 Berapa perkiraan pengeluaran rumah tangga anda perbulan?

- ○ a. Rp 100,000-Rp 500,0000
- ○ b. Rp 500,001-Rp 1000,000
- ○ c. Rp 1,000,001-Rp 1,500,000
- ○ d. Rp 1,500,001-Rp 2,000,000
- ○ e. Rp2,000,001-Rp 2,500,000
- ○ f. Lebih dari Rp 2,500,000

b. The Business Profile

Pertanyaan pertanyaan berikut ini akan berusaha mencari gambaran tentang struktur organisasi pertambakan dan skala ekonominya. Pada bagian ini akan ditanyakan dua pertanyaan penting, pertama adalah kondisi tambak, kedua adalah struktur usaha termasuk didalamnya nilai usaha dan para pekerjanya

11. Dari daftar tabel berikut ini mana yang paling dekat dengan menggambaran tambak anda? Tolong beri tanda silang atau centang yang menggambarkan kondisi tambak anda!

Catatan: bisa dijawab lebih dari satu jawaban

Jenis	Methode Budidaya	Jenis Budidaya	Sarana
○ a.Tambak	○ a. Traditional ○ b. Semi intensive ○ c. Intensive ○ d. Organik ○ e. Lainnya, Mohon jelaskan…… …… ……	○ 1.Udang ○ 2. Bandeng ○ 3. udang dan bandeng ○ 4. Udang, bandeng dan Lainnya ○ 5. Pemrosesan ○ 99. Lainnya Mohon jelaskan…… … ……	○ a. Airpayau ○ b. Airpayau (yang diambil /dikombinasi dari sungai terdekat) ○ c. Airtawar ○ d. Air Tawar (berasal dari sungai terdekat) ○ e. Air Asin (laut) ○ f. Lainnya, Mohon jelaskan…… ……

Jenis	Methode Budidaya	Jenis Budidaya	Sarana
○ b.Kolam	○ a. Traditional ○ b. Semi intensive ○ c. Intensive ○ d. Organik ○ e. Lainnya, Mohon jelaskan…… …… ……	○ 1.Udang ○ 2. Bandeng ○ 3. Udang dan bandeng ○ 4. Udang, bandeng dan Lainnya ○ 5. Pemrosesan ○ 99. Lainnya Mohon jelaskan…… … ……	○ a. Airpayau ○ b. Airpayau (yang diambil /dikombinasi dari sungai terdekat) ○ c. Airtawar ○ d. Air Tawar (berasal dari sungai terdekat) ○ e. Air Asin (laut) ○ f. Lainnya, Mohon jelaskan……

		…….

12 Apakah anda tahu kapan pertama kali tambak ini anda ini beroperasi?

- ○ Tanggal/Bulan/Tahun: ……/……/……..
- ○ Kurang tahu

13 Dilokasi tambak ini apakah selalu membududayakan ikan atau udang? (sebelum jadi tambak berupa apa?)

- ○ 1. Ya
- ○ 3. Tidak…….Lihat ke 14

14 Jika sebelumnya bukan berupa tambak ikan atau udang, berupa apakah?
Catatan: bisa dijawab lebih dari satu jawaban

- ○ A. Sawah/Pagi
- ○ B. Mangrove
- ○ C. Rawa
- ○ D. Padang Rumput
- ○ V. Lainnya, Mohon jelaskan……

15 Apakah Perusahaan tambak tempat anda bekerja mempunyai ijin usaha? Jika Ya, dalam bentuk apakah ijin usaha tersebut dan bagaimana status kepemilikian usaha pertambakan yang anda miliki?

○ 1 Ya

Jenis Perusahaan	Tanggal berdiri	Status kepemilikan
○ 1 Perseroan Terbatas/PT	(……../……../……..)	○ 1 Milik Individu
○ 2 Commendatory (CV)	(……../……../……..)	○ 2 Sewa
○ 3 Perusahaan Dagang	(……../……../……..)	○ 3 Mengunakan dengan Cuma Cuma
○ 99 Lainnya, Mohon jelaskan…… …… …… .	(……../……../……..)	○ 99 Lainnya, Mohon jelaskan…… …… …… ……

○ 3 Tidak memiliki ijin usaha

16 Berapakah luas area yang digunakan oleh tambak dimana anda bekerja?

- ○ a. Tanah: ……M2
- ○ b. Bangunan……M2

17 Berapakah perkiraan nilai total aset dari tambak dimana anda bekerja?
Rp:…….

18 Apakah usaha tambak dimana anda bekerja memiliki TDP- Tanda Daftar Perusahaan)

- ○ 1.Ya , sejak……/……/……
- ○ 3.No…….go to 28

19 Apakah anda memiliki NPWP (Nomor Pokok Wajib Pajak)?

- ○ 1.Ya , sejak Kapan……/……/……
- ○ 3.Tidak

20 Apakah anda diberi tanggung jawab dari salah satu yang tercantum dalam tabel berikut ini dari perusahaan tempat anda bekerja ?

○	1.	Catatan Penasukan atau Catatan belanja perusahaan	○	1	Ya	○	3 No
○	2.	Jurnal Harian	○	1	Ya	○	3 No
○	3.	Jurnal Rugi Laba	○	1	Ya	○	3 No
○	4.	Jurnal pendapatan	○	1	Ya	○	3 No
○	95.	Lainnya_____	○	1	Ya	○	3 No

21 Bisakah anda memperkirakan modal awal dalam memulai usaha ini?
Catatan: modal awal yang dimaksud selain tanah dan bangunan

○ 1 Ya
- ○ a. Kurang dari Rp 2,500,0000
- ○ b. Rp 2500,001-Rp 5000,000
- ○ c. Rp 5,000,001-Rp 7,500,000
- ○ d. Rp 7,500,001-Rp 10,000,000
- ○ e. Rp10,000,001-Rp 12,500,000
- ○ f. Lebih dari Rp 12,500,000

○ 3 Tidak, Lihat ke no 23

22 Diperusahaan tambak tempat anda bekerja, apakah modal yang didapat digunakan untuk keperluan berikut ini?
Note: Beritanda skala priorias, 1 sebagai posisi yang paling penting

☐	A.	Menyewa tambak dilokasi lain
☐	B.	Untuk membeli pakan udang
☐	C.	Untuk membayar gaji pekerja
☐	D.	Untuk membeli mesin, Mohon jelaskan……
☐	E.	Untuk Gaji Konsultan
☐	F.	Untuk memulai usaha baru, Mohon jelaskan……..
☐	V.	Lainnya, Mohon jelaskan ……

23 Dari daftar berikut ini, mana yang menjadi salah satu sumber pembiayaan tempat anda bekerja?
Catatan: Beri tanda semua jawaban yang sesuai (bisa lebih dari 1 jawaban)

- ○ A. Bank,……(Nama Bank)
- ○ B. Lembaga Keuangan Mikro,……(Nama Lembaga)
- ○ C. Pegadaian
- ○ D. Rentenir
- ○ E. Bantuan Pemerintah
- ○ F. Beli kredit dari…….
- ○ G Rekan kerja atau Keluarga
- ○ V. Lainnya, Mohon jelaskan ……

24 Apakah anda tahu berapa biaya operasional dari usaha tambak tempat anda bekerja ini?

Catatan: biaya operasional yang dimaksud meliputi biaya gaji pegawai, biaya transportasi, biaya bahan baku dan lainnya

- ○ 1 Ya saya tahu, Rp……
- ○ 3 Tidak, saya tidak dilibatkan

25 Berapa sering tambak udang anda ini dipanen?

- ○ A. Sekali setahun
- ○ B. Dua kali setahun
- ○ C. Tiga kali setahun
- ○ D. Empat kali setahun
- ○ V. Lebih dari lima tahun setahun, Mohon jelaskan……
  ……

26 Bisakah anda memperkirakan pendapatan kotor tahunan dari perusahaan tambak tempat anda bekerja ini?

Catatatan: Jika Kurang tahu, berita perkiraan

- ○ 1 Ya
  - ○ a. Kurang dari Rp 25,000,0000
  - ○ b. Rp 25,000,001-Rp 50,000,000
  - ○ c. Rp 50,000,001-Rp 75,000,000
  - ○ d. Rp 75,000,001-Rp 100,000,000
  - ○ e. Rp100,000,001-Rp 125,000,000
  - ○ f. Lebih dari Rp 125,000,000
- ○ 3 No

27 Apakah pendapatan kotor usaha/tambak tempat anda bekerja ini mengalami perubahan dalam enam tahun terakhir ini?

- ○ 1. Ya
- ○ 3. Tidak…….Lihat ke ……31

28 Jika Ya, apakah salah satu diantara daftar berikut ini mempengaruhi perubahan pendapatan tempat anda bekerja?

Catatan: Jika Kurang tahu, berita perkiraan

- ○ A. Munculnya Lumpur Panas di Porong
- ○ B. Kondisi makro ekonomi nasional
- ○ C. Kenaikan harga harga bahan baku
- ○ D. Jatuhnya harga udang
- ○ E. Peraturan/regulasi pemerintah, Mohon jelaskan……
- ○ V. Lainnya, Mohon jelaskan ……..

29 Apakah perubahan ini sangat mempengaruhi secara significant?

- ○ A. Ada perubahan tapi tidak significant
- ○ B. Turun drastis sangat significant, Berapa ……%
- ○ C. Hanya dimusin kemarau , Berapa ……%
- ○ D. Hanya dimusim Hujan, Berapa ……%
- ○ V. Lainnya, Mohon jelaskan ……..

30 Apakah biaya operasional mengalami perubahan dalam enam tahun terakhir?

- ○ 1 Ya
- ○ 3 Tidak Tahu, lihat ke 31

31 Biaya operaional manakah yang paling dipengaruhi

Note: Beritanda skala priorias, 1 sebagai posisi yang paling penting

- ☐ A. Upah dan Gaji
- ☐ B. Bahan Baku
- ☐ C. Cicilan Bank

☐	D.	Peralatan
☐	E.	Pemeliharaan
☐	V.	Lainnya, Mohon jelaskan ……

Profile Pekerja

Pertanyaan berikut ini adalah untuk menggambarkan profile pekerja yang bekerja di Industri Perudangan

32 Berapa jumlah pekerja yang anda pekerjakan dalam tambak udang anda?

……

33 Dari pekerja anda mohon diidentifikasi tempat tinggal dari pekerja anda berdasar dari kriteria berikut ini?

Catatan : Jawaban dapat lebih dari satu:

○	A.	Tinggal di masyarakat yang dekat dengan lokasi tambak……..Orang
○	B.	Di desa lain tapi satu kecamatan.....Orang
○	C.	Didesa lain, dikecamatan lain tapi satu kabupaten,…….. orang
○	D.	Diluar Kabupaten
○	V.	Lainnya

34 Apakah anda memiliki hubungan keluarga dengan pemilik/ manager tambak ini?

○	1.	Ya
○	3.	Tidak

35 Apakah ada anggota keluarga anda yang bekerja di tambak ini?

○	1.	Ya , ……Orang
○	3.	Tidak……lihat ke 37

36 Hubungan dengan Anda

Catatatan: Tandai yang relevan

○	A.	Anak
○	B.	Istri
○	C.	Saudaranya Istri
○	D.	Saudara Anda
○	V.	Lainnya, Mohon jelaskan ……..

37 Apa alasannya mereka bersedia bekerja di sektor ini bersama anda?

Catatan: bisa dijawab lebih dari satu jawaban

- ○ A. Mereka butuh pekerjaan
- ○ B. Mereka dapat dipercaya
- ○ C. Tidak perlu digaji mahal
- ○ D. Mereka memiliki ketrampilan yang dibutuhkan
- ○ E. Tidak punya pilihan lain
- ○ V. Lainnya, Mohon jelaskan ……..

Pertanyaan pertanyaan berikut ini dimaksudkan untuk menggali rantai pemasaran dari perusahaan tambak udang anda dalam rangka memahami signifikansi atas sektor pertambakan kepada sektor lainnya

38 Apakah anda dilibatkan dalam pemasaran produk perusahaan anda?

○ 1 Ya ○ 3 Tidak, saya tidak dilibatkan, Lihat ke 46

39 Bagian pemasaran/marketing apakah yang menjadi tanggung jawab anda?

- ○ A Menjualnya di masyarakat sekitar
- ○ B Membantu di Pengemasan untuk eksport
- ○ V Lainnya_____

40 Dari daftar berikut ini, pasar manasaja yang biasanya dilayani oleh perusahaan tempat anda bekerja?
Note: Beritanda skala priorias, 1 sebagai posisi yang paling penting

- ☐ 1. Pasar Local (satu desa)
- ☐ 2. Sekitar Sidoarjo
- ☐ 3. Kota kota lain di Propinsi Jawa timur
- ☐ 4. Pasar Indonesia umumnya diluar propinsi jawatimur
- ☐ 5. Eksport ke Luar negeri
- ☐ 95. Lainnya_____

41 Methode pembayaran yang anda gunakan dalam transaksi perusahaan tempat anda bekerja?
Note: Beritanda skala priorias, 1 sebagai posisi yang paling penting

- ☐ A. Pembayaran langsung cash
- ☐ B. Credit
- ☐ V. Lainnya,……..

42 Alat pembayaran yang digunakan
Note: Beritanda skala priorias, 1 sebagai posisi yang paling penting

☐	A.	Cash
☐	B.	Kartu Debit (Debit Card)
☐	C.	Kartu Kredit (Credit Card)
☐	D.	Cheque
☐	E.	Bank Transfer
☐	V.	Lainnya, Mohon jelaskan ……..

43 Berapa persen produk tambak tempat anda bekerja yang dipasarkan di pasar tradisional ?
Catatatan: Tandai satu saja

- ○ A. 1-5%
- ○ B. 6-15%
- ○ C. 16-20%
- ○ D. 21-25%
- ○ E. Lebih dari 25%

44 Berapa prosentasi produksi anda yang dipasarkan ke Luar negeri
Catatatan: Tandai satu saja

- ○ A. 1-10%
- ○ B. 11-20%
- ○ C. 21-30%
- ○ D. 31-40%
- ○ E. 41-50%
- ○ F. Lebih dari 50%

45 Dari daftar berikut ini jenis produk apakah yang dijual oleh perusahaan tempat anda bekerja kepada pembeli potensial?
Catatatan: Beritanda skala priorias, 1 sebagai posisi yang paling penting

☐	A.	Life Shrimps (udang Hidup)
☐	B.	HOSO (Head On Shell On)
☐	C.	HLSO (Head Less Shell On)
☐	D.	PD (Peel Devine)
☐	V.	Lainnya, Mohon jelaskan……..

46 Bagaimana anda mengirim hasil panen tambak tempat anda bekerja ke pasar?

- ○ A. Diambil langsung oleh Pembeli
- ○ B. Kami mengirimnya depot dengan kendaraan sendiri
- ○ C. Mengunakan jasa pengiriman
- ○ D. Semua pengiriman di koordinasikan oleh assosiasi petani tambak
- ○ V. Lainnya, Mohon jelaskan……..

47 Seberapa pentingkan pasar berikut ini menurut prespektif anda

			Very Important ⇒⇒Less Important				
			1	2	3	4	5
☐	A.	Export	○	○	○	○	○
	B.	Restaurants	○	○	○	○	○
	C.	Perusahaan Krupuk Udang(Shrimp Crackers)	○	○	○	○	○
	D.	Perusahaan Petis udang (Shrimp Paste)	○	○	○	○	○
☐	E.	Perusahaan makanan kecil (Shrimp Nibles)	○	○	○	○	○
	F.	Perusahaan pengexport udang	○	○	○	○	○
	G	Pasar Traditional	○	○	○	○	○
☐	V.	Lainnya, Mohon jelaskan……..	○	○	○	○	○

c. Perubahan operasional Pengelolaan Tambak

Bagian ini bertujuan untuk mengali informasi tentang proses produksi udang sebelum dan sesudah munculnya bencana lumpur panas di Porong.

48 Dimanakah perusahaan tambak anda memperoleh bahan bahan budidaya udang berikut ini ?

Bibit Udang		Pakan Udang		Peralatan pertambakan	
○ A.	Capture directly from The sea	○ A.	Scheduled by the association	○ A.	Assembling it self
○ B.	From agent recommended by the Agricultural Assistance Official (Petugas Penyuluh Pertanian)	○ B.	Scheduled by the Agricultural Assistance official (Petugas Penyuluh Pertanian)	○ B.	Assisted by the Agricultural Assistance Official (Petugas Penyuluh Pertanian)
○ C.	Supplied by the depot	○ C.	Direct order from the store based on your need	○ C.	Supplied by the depot
○ D.	Supplied by the buyers	○ D.	Ordered from Association according to the need (on demand)	○ D.	Supplied from buyer
○ E.	Purchased from hatchery	○ E.	Supplied by the buyers	○ E.	Purchase from the store
○ V.	Lainnya, Mohon jelaskan…… ……	○ V.	Lainnya, Mohon jelaskan …… ……..	○ V.	Lainnya, Mohon jelaskan…… …… …

49 Metode pengiriman bahan baku budidaya udang

Bibit Udang	Pakan Udang	Peralatan pertambakan
○ A. Dikirim oleh penjual	○ A. Dikirim oleh penjual	○ A. Dikirim oleh penjual
○ B. Mengambil dari toko sendiri	○ B. Mengambil dari toko sendiri	○ B. Mengambil dari toko sendiri
○ C. Menggunakan jasa pengiriman	○ C. Menggunakan jasa pengiriman	○ C. Menggunakan jasa pengiriman
○ D. Dikoordinasikan oleh paguyupan	○ D. Dikoordinasikan oleh paguyupan	○ D. Dikoordinasikan oleh paguyupan
○ V. Lainnya, Mohon jelaskan……	○ V. Lainnya, Mohon jelaskan……..	○ V. Lainnya, Mohon jelaskan……

50 Dalam enam tahun terakhir, apakah ada perubahan dalam mendapatkan bahan baku budidaya udang?

○ A. Ya , Jelaskan perubahan yang dimaksud……
……

○ B. Tidak……go to 53

51 Dari daftar berikut ini , faktor apa saja yang mempengaruhi perubahan menyediaan / ketersediaan bahan baku budidaya udang?
Note: bisa dijawab lebih dari satu jawaban

○ A. Munculnya Lumpur Panas di Porong
○ B. Kondisi perekonomian makro nasional
○ C. Harga bahan makanan udang
○ D. Harga udang turun
○ E. Regulasi Pemerintah, Mohon jelaskan……
○ V. Lainnya, Mohon jelaskan ……..

52 Kesulitan bahan baku ini muncul kapan?

○ A. Sebelum 29 Mai 2006
○ B. Sesudah 29 Mai 2006
○ V. Lainnya, Mohon jelaskan……

53 Bagaimana perubahan pada level produski

○ A. Sudden drop
○ B. sudden death
○ c sudden stock loss
○ V. Lainnya, Mohon jelaskan……

54 Dalam enam tahun terakhir, apakah tambak udang dimana anda bekerja mengalami perubahan metode budidaya yang dilakukan?

○ 1. Ya
○ 3. Tidak…….Lihat ke 76

55 Dari daftar berikut ini apakah mempengaruhi level produksi

			Sangat Penting ⇒⇒Kurang Penting				
			1	2	3	4	5
	A.	Munculnya lumpur panas di porong	○	○	○	○	○
	B.	Kondisi ekonomi makro nasional	○	○	○	○	○
	C.	Harga makanan udang	○	○	○	○	○
	D.	Harga jual udang rendah	○	○	○	○	○
	E.	Peraturan Pemerintah, Mohon jelaskan…….	○	○	○	○	○
	V.	Lainnya, Mohon jelaskan ……..	○	○	○	○	○

56 Apakah anda mempraktekkan teknik dan metode khusus dalam budidaya udang khususnya terkait masalah penurunan kualitas air yang kemungkinan diakibatkan oleh adanya bencana lumpur panas di Porong?

○ 1 Ya Mohon jelaskan.....

○ 3 Tidak

57 Apakah ada kearifan lokal atau tradisi yang menginspirasi teknik budadaya udang yang anda lakukan?

○ 1 Ya Mohon jelaskan.....
.....

○ 3 Tidak

58 Apakah pemberi kerja anda mendorong dan mendukung pengembangan teknik budidaya udang yang baru?

○ 1 Ya , berupa apakah dukungan tersebut? ……..
……..

○ 3 Tidak

59 Apakah saat ada dukungan pemerintah untuk meningkatkan kualitas panen?

○ 1 Ya

○ 3 Tidak, liat ke 61

60 Manakah dari daftar program pemerintah berikut ini yang paling dibutuhkan untuk meningkatkan kualitas panen?

Note: Beritanda skala priorias, 1 sebagai posisi yang paling penting

☐	A.	Bantuan Teknik
☐	B.	Bantuan Keuangan
☐	C.	Membantu proses pasca panen / bantuan pemasaran
☐	D.	Mengenalkan contoh ideal
☐	V.	Lainnya, Mohon jelaskan.....

61 Dari daftar lembaga berikut ini bagaimana derajat kegunaan dalam mendukung peningkatan produktifitas udang?

		Sangat Penting ⇒⇒Kurang Penting				
		1	2	3	4	5
A.	Pusat/Lembaga Penelitian Perguruan Tinggi	○	○	○	○	○
B.	Lembaga Penelitian Komersial	○	○	○	○	○
C.	Lembaga Penelitian perusahaan Exporter	○	○	○	○	○
D.	Penelitian mandiri dari masyarakat	○	○	○	○	○
V.	Lainnya, Mohon jelaskan……	○	○	○	○	○

62 Jika anda memiliki dukungan yang memadai misalkan mendapatkan pelatihan apakah ada mau merubah teknik budidaya udang yang anda lakukan?

○ 1. Ya
○ 3. Tidak, Konsekwensi apa yang mungkin anda terima……Lihat ke 76

63 Jika Ya , apakah alasan anda untuk merubah metode budidaya anda?
Catatan: bisa dijawab lebih dari satu jawaban

○ A. Meningkatkan produktifitas, sampai……..%
○ B. Mengurangi resiko kegagalan panen
○ C. Mengikuti kawan kawan petambak lainnya
○ D. Untuk mendapatkan insentive yang ditawarkan
○ V. Lainnya, Mohon jelaskan ……..

64 Metode apakah yang anda terapkan untuk menjaga kualitas air yang digunakan?

○ A. Menanam pohon mangroves disekitar tambak
○ B. Mengunakan penyaring air
○ C. Tidak melakukan apa apa
○ D. Menggunakan bibit unggul
○ E. Lainnya, Mohon jelaskan……

65 Apakah ada bantuan dari luar masyarakat dalam penanggulangan polusi?
Note: if ya , bisa dijawab lebih dari satu jawaban

○ 1 Ya

○	A	Lembaga Pemerintah
○	B	Perusahaan (bagian dari program CSR)
○	C	NGO/LSM
○	D	Perusahaan pengesxport udang
○	E	Lainnya, Mohon jelaskan…… …… ……

○ 3 Tidak ada, lihat ke 68

66 Dari bantuan yang berasal dari luar masyarakat berikut ini, bantuan yang bagaimana yang paling dibutuhkan di menanggulangan polusi dan atau peningkatan kualitas panen?
Catatan: Beritanda skala priorias, 1 sebagai posisi yang paling penting

☐	A.	Bantuan Teknik
☐	B.	Bantuan Pembiayaan
☐	C.	Memfasilitasi proses pasca panen/ bantuan pemasaran
☐	D.	Mengenalkan model baru
☐	V.	Lainnya, Mohon jelaskan……

67 Berapa lama bantuan tersebut anda terima?

○ A. Kurang dari 1 bulan

- ○ B. 1-3 bulan
- ○ C. 4-6 Bulan
- ○ D. Satu tahun
- ○ E. Lebih dari satu tahun

68 Inisiatif apasaja yang telah anda lakukan sendiri dalam rangka mengurangi polusi dan meningkatkan kualitas panen?

- ○ A. Melakukan percobaan sendiri
- ○ B. Melakukan dengan asosiasi petani
- ○ C. Mencari masukan dan nasehat dari petani lain atau assosiasi petani udang diluar kabupaten sidoarjo
- ○ D. Mencari masukan dan nasehat dari petani lain atau assosiasi petani udang diluar kabupaten sidoarjo
- ○ E. Lainnnya, Mohon jelaskan.....

c. Perubahan yang terjadi terkait dengan Lumpur Panas Porong

Bagian ini ingin menggambarkan pandangan petani udang atas kemunculan Lumpur panas di Porong

Catatan: SS= Sangat Setuju, S= Setuju, N=nentral, STS= Sangat Tidak setuju

No	Pernyataan	No	Pilihan Jawaban				
			SS	S	N	TS	STS
1	Apakah anda sadar bila bencana lumpur panas di porong mempengaruhi kehidupan sosial anda?	1	○	○	○	○	○
2	Apakah hubungan anda dengan pekerja tambak udang udang lainnya berubah semenjak munculnya lumpur panas di Porong?	2	○	○	○	○	○
3	Sebagai pekerja tambak udang, apakah pola komunikasi anda dengan komunitas sekitar berubah semenjak munculnya lumpur panas di Porong?	3	○	○	○	○	○
4	Apakah komunikasi dengan assosiasi petani udang effective?	4	○	○	○	○	○
5	Dalam rangka mengantisipasi terhadap dampak lumpur panas di Porong apakah anda menerapkan teknik baru dalam budidaya udang?	5	○	○	○	○	○
6	Apakah perusahaan dimana anda bekerja mendapatkan bantuan dari pemerintah?	6	○	○	○	○	○
7	Apakah bank atau lembaga keuangan juga dibutuhkan dalam rangka membantu penyelesaian masalah yang dihadapi petani Udang?	7	○	○	○	○	○
8	Apakah dukungan masyarakat sekitar dibutuhkan untuk menyelesaiakan masalah yang dihadapi petani udang?	8	○	○	○	○	○
9	Apakah dukungan perusahaan pengexport udang dibutuhkan menyelesaiakan masalah yang dihadapi petani udang?	9	○	○	○	○	○
10	Apakah anda merasa lebih beruntung dibanding dengan petani udang lainnya?	10	○	○	○	○	○
11	Apakah anda perlu merubah usaha inti anda?	11	○	○	○	○	○
12	Menurut anda , Apakah pemerintah harus memberi bantuan kepada anda?	12	○	○	○	○	○

13	Menurut anda , Apakah PT Lapindo harus memberi bantuan kepada anda?	13	○	○	○	○	○

Apakah anda berusia 18 tahun atau lebih?, Apakah anda saat ini adalah pengelola (manajer) disalah satu tambak udang yang berada disalah satu wilayah berikut ini? : Gebang, Sekardangan (Kec. Sidoarjo), Kedung Peluk (Kec. Candi), BanjarPanji, Banjar Asri, Penatar Sewu (Kec. Tanggulangin) Plumbon (Kec. Porong), Permisan, Tambak Kalisogo, Kupang, Kedung Pandan (Kec. Jabon), Sawohan (Kec. Buduran), Kalanganyar, Tambak Cemandi, Banjar Kemuning (Kec. Sedati) and Tambak Sawah (Kec. Waru)

Jika iya, kami berharap anda bersedia berpartisipasi dalam survey ini..

Survey ini berusaha menggali informasi tentang respon petani udang, pemerintah dan pihak terkait atas terjadinya bencan lumpur vulkanik di Porang pada wilayah tertentu yang menjadi target penelitian. Survey ini terfokuskan pada: tingkat kontaminasi dan gangguan yang dialami petambak udang atas munculnya Lumpur panas di Porong; dampak sosial-ekonomi dari gangguan yang muncul terhadap produksi tambak udang; metode dan tekhnik yang dilakukan oleh petambak udang dalam menyikapi potensi ancaman yang muncul; peranan pemerintah dalam dukungannya kepada petambak udang dalam menanggulangi potensi polusi; sejauh mana dukungan pemerintah terhadap usaha yang terdampak; sejauhmana innovasi yang dilakukan oleh petani udang di Sidoarjo bisa diadopsi di daerah lain di Indonesia.

Survey ini memakan waktu 60 menit. Nama dan identitas anda akan dirahasiakan dalam survey ini

Survey ini dipersiapkan oleh Achmad Room Fitrianto sebagai bagian dari penelitian yang bersangkutan untuk memperoleh gelar PhD Pada The School of Social Science and Asian Languages Curtin University, Perth. Judul PhD thesis yang diajukan adalah “The socio-economic impacts of the Porong mud flow on the shrimp fisheries sector in Sidoarjo District, East Java Province Indonesia". Penelitian ini dibawah bimbingan Prof. Dr. Bob Pokrant dan Dr. Aileen Hoath dari Curtin University.

Penelitian ini akan menyelidiki setiap dampak dari bahaya yang disebabkan manusia atau alam yang mempengaruhi kondisi sosial ekonomi dari Industri udang. Dengan menggambarkan berbagai kerentanan yang berpotensi terjadi di komunitas, penelitian ini akan membantu mengidentifikasi sumber utama kerentanan dan kelompok-kelompok lokal tertentu yang paling terpengaruh oleh mereka, dengan cara ini masyarakat akan berada dalam posisi yang lebih baik untuk menanggapi keprihatinan dengan cepat dan juga merencanakan untuk segala kemungkinan di masa depan.

Penelitian doktoral ini didukung oleh Kementerian Pendidikan dan Kebudayaan, Direktorat Pendidikan Tinggi Indonesia dibawah program beasiswa DIKTI Bench 5

Penelitian ini sudah sesuai dengan prosedur ethic dari Curtin University. Semua data yang dikumpulkan sesuai dengan pedoman penelitian perguruan tinggi untuk melindungi anonimitas masing-masing narasumber atau obyek penelitian. Setiap publikasi yang dihimpun dari survey ini akan dicantumkan sebagai informasi

Kesediaan anda untuk mengisi survey ini akan dipahami sebagai bentuk kesediaan anda dalam berpartisipasi dalam penelitian ini dan kesediaan untuk mengijinkan mengunakan informasi yang anda berikan untuk kepentingan ilmiah penelitian ini

Untuk Keterangan lebih lanjut tentang penelitian ini, tujuan penelitian anda dapat menghubungi Achmad Room Fitrianto

Achmad Room Fitrianto
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No. Questionnaire :		**Tanggal :**			
No. Desa :		**No. Kecamatan :**			

Silahkan beri tanda silang atau centang salah satu pilihan jawaban berikut ini

a. **Data demografi dasar**

Bagian berikut ini akan menampilkan profil dari responden penelitian ini.

1 Apakah gender anda?

○ a. Laki Laki ○ b. Perempuan

2 Berapakah Usia anda?

○ a.18-25 ○ c. 46-65

○ b.26-45 ○ d. 66+

3 Latar pendidikan/ pendidikan tertinggi yang dicapai

○ a. SD ○ b. SMA

○ c. SMP ○ d. Perguruan Tinggi

○ e. Lainnya, Mohon jelaskan ……

……..

4 Sudah berapa lama anda bekerja di tambak ini?

○ a. Kurang dari setahun ○ c. 5-10

○ b. 1 -5 Tahun ○ d. >10 Tahun

5 Sudah berapa lama anda bekerja dengan posisi ini?

○ a. Kurang dari setahun ○ c. 5-10

○ b. 1 -5 Tahun ○ d. >10 Tahun

Data Rumah Tangga

6 Berapa anggota keluarga anda yang tinggal serumah dengan anda?

○ a.2-4 Orang ○ c.7-9 Orang

○ b.5-6 Orang ○ d. Lebih dari 10 Orang

Silahkan isi tabel berikut ini dari anggota keluarga anda tersebut

No.	Nama (inisial)	Hubungan dengan resonden	Gender		usia	Tingkat Pendidikan	Pekerjaan Saat ini
1.			L	P			1.
2.			L	P			2.
3.			L	P			3.
4.			L	P			4.
5.			L	P			5.
6.			L	P			6.

7.			L	P			7.

7. Apakah ada diantara anak anda atau anggota keluarga yang lain yang bekerja di perusahaan (tambak) yang sama dengan anda?

   ○ a. Ya, Sektor dan perusahaan yang sama
   ○ b. Ya, Tapi beda perusahaan
   ○ c. Tidak

8. Berapa perkiraan total pendapatan anda dari bekerja di tambak udang termasuk bonus dan insetiv lainnya

   ○ a. Rp 100,000-Rp 500,0000
   ○ b. Rp 500,001-Rp 1000,000
   ○ c. Rp 1,000,001-Rp 1,500,000
   ○ d. Rp 1,500,001-Rp 2,000,000
   ○ e. Rp2,000,001-Rp 2,500,000
   ○ f. Lebih dari Rp 2,500,000

9 Bagaimana cara anda di bayar/gaji?
Catatan: bisa dijawab lebih dari satu jawaban

   ○ A. Mingguan
   ○ B. Bulanan
   ○ C. Komisi, berapa persen?
   ○ D. Bagi hasil
   ○ **V. Lainnya, Mohon jelaskan ……..**

10 Berapa perkiraan pengeluaran rumah tangga anda perbulan?

   ○ a. Rp 100,000-Rp 500,0000
   ○ b. Rp 500,001-Rp 1000,000
   ○ c. Rp 1,000,001-Rp 1,500,000
   ○ d. Rp 1,500,001-Rp 2,000,000
   ○ e. Rp2,000,001-Rp 2,500,000
   ○ f. Lebih dari Rp 2,500,000

b. The Business Profile

Pertanyaan pertanyaan berikut ini akan berusaha mencari gambaran tentang struktur organisasi pertambakan dan skala ekonominya. Pada bagian ini akan ditanyakan dua pertanyaan penting, pertama adalah kondisi tambak, kedua adalah struktur usaha termasuk didalamnya nilai usaha dan para pekerjanya

11. Dari daftar tabel berikut ini mana yang paling dekat dengan menggambaran tambak anda? Tolong beri tanda silang atau centang yang menggambarkan kondisi tambak anda!

Catatan: bisa dijawab lebih dari satu jawaban

Jenis	Methode Budidaya	Jenis Budidaya	Sarana
○ a.Tambak	○ a. Traditional ○ b. Semi intensive ○ c. Intensive ○ d. Organik ○ e. Lainnya, Mohon jelaskan…… …… ……	○ 1.Udang ○ 2. Bandeng ○ 3. udang dan bandeng ○ 4. Udang, bandeng dan Lainnya ○ 5. Pemrosesan ○ 99. Lainnya Mohon jelaskan…… … ……	○ a. Airpayau ○ b. Airpayau (yang diambil /dikombinasi dari sungai terdekat) ○ c. Airtawar ○ d. Air Tawar (berasal dari sungai terdekat) ○ e. Air Asin (laut) ○ f. Lainnya, Mohon jelaskan…… ……

Jenis	Methode Budidaya	Jenis Budidaya	Sarana
○ b.Kolam	○ a. Traditional ○ b. Semi intensive ○ c. Intensive ○ d. Organik ○ e. Lainnya, Mohon jelaskan…… …… ……	○ 1.Udang ○ 2. Bandeng ○ 3. Udang dan bandeng ○ 4. Udang, bandeng dan Lainnya ○ 5. Pemrosesan ○ 99. Lainnya Mohon jelaskan…… … ……	○ a. Airpayau ○ b. Airpayau (yang diambil /dikombinasi dari sungai terdekat) ○ c. Airtawar ○ d. Air Tawar (berasal dari sungai terdekat) ○ e. Air Asin (laut) ○ f. Lainnya, Mohon jelaskan……

		…….

12 Apakah anda tahu kapan pertama kali tambak ini anda ini beroperasi?

- ○ Tanggal/Bulan/Tahun: ……/……/……..
- ○ Kurang tahu

13 Dilokasi tambak ini apakah selalu membududayakan ikan atau udang? (sebelum jadi tambak berupa apa?)

- ○ 1. Ya
- ○ 3. Tidak…….Lihat ke 14

14 Jika sebelumnya bukan berupa tambak ikan atau udang, berupa apakah?
Catatan: bisa dijawab lebih dari satu jawaban

- ○ A. Sawah/Pagi
- ○ B. Mangrove
- ○ C. Rawa
- ○ D. Padang Rumput
- ○ V. Lainnya, Mohon jelaskan……

15 Apakah Perusahaan tambak tempat anda bekerja mempunyai ijin usaha? Jika Ya, dalam bentuk apakah ijin usaha tersebut dan bagaimana status kepemilikian usaha pertambakan yang anda miliki?

○ 1 Ya

Jenis Perusahaan	Tanggal berdiri	Status kepemilikan
○ 1 Perseroan Terbatas/PT	(……../……../……..)	○ 1 Milik Individu
○ 2 Commendatory (CV)	(……../……../……..)	○ 2 Sewa
○ 3 Perusahaan Dagang	(……../……../……..)	○ 3 Mengunakan dengan Cuma Cuma
○ 99 Lainnya, Mohon jelaskan…… …… …… .	(……../……../……..)	○ 99 Lainnya, Mohon jelaskan…… …… …… ……

○ 3 Tidak memiliki ijin usaha

16 Berapakah luas area yang digunakan oleh tambak dimana anda bekerja?

- ○ a. Tanah: ……M2
- ○ b. Bangunan……M2

17 Berapakah perkiraan nilai total aset dari tambak dimana anda bekerja?
Rp:…….

18 Apakah usaha tambak dimana anda bekerja memiliki TDP- Tanda Daftar Perusahaan)

- ○ 1.Ya , sejak……/……/……
- ○ 3.No…….go to 28

19 Apakah anda memiliki NPWP (Nomor Pokok Wajib Pajak)?

- ○ 1.Ya , sejak Kapan……/……/……
- ○ 3.Tidak

20 Apakah anda juga bertanggung jawab dari salah satu yang tercantum dalam tabel berikut ini dari perusahaan tempat anda bekerja ?

○	1. Catatan Penasukan atau Catatan belanja perusahaan	○	1	Ya	○ 3	No
○	2. Jurnal Harian	○	1	Ya	○ 3	No
○	3. Jurnal Rugi Laba	○	1	Ya	○ 3	No
○	4. Jurnal pendapatan	○	1	Ya	○ 3	No
○	95. Lainnya_____	○	1	Ya	○ 3	No

21 Bisakah anda memperkirakan modal awal dalam memulai usaha ini?
Catatan: modal awal yang dimaksud selain tanah dan bangunan

○ 1 Ya
- ○ a. Kurang dari Rp 2,500,0000
- ○ b. Rp 2500,001-Rp 5000,000
- ○ c. Rp 5,000,001-Rp 7,500,000
- ○ d. Rp 7,500,001-Rp 10,000,000
- ○ e. Rp10,000,001-Rp 12,500,000
- ○ f. Lebih dari Rp 12,500,000

○ 3 Tidak, Lihat ke no 23

22 Diperusahaan tambak tempat anda bekerja, apakah modal yang didapat digunakan untuk keperluan berikut ini?
Note: Beritanda skala priorias, 1 sebagai posisi yang paling penting

☐	A.	Menyewa tambak dilokasi lain
☐	B.	Untuk membeli pakan udang
☐	C.	Untuk membayar gaji pekerja
☐	D.	Untuk membeli mesin, Mohon jelaskan……
☐	E.	Untuk Gaji Konsultan
☐	F.	Untuk memulai usaha baru, Mohon jelaskan……..
☐	V.	Lainnya, Mohon jelaskan ……

23 Dari daftar berikut ini, mana yang menjadi salah satu sumber pembiayaan tempat anda bekerja?
Catatan: Beri tanda semua jawaban yang sesuai (bisa lebih dari 1 jawaban)

- ○ A. Bank,……(Nama Bank)
- ○ B. Lembaga Keuangan Mikro,……(Nama Lembaga)
- ○ C. Pegadaian
- ○ D. Rentenir
- ○ E. Bantuan Pemerintah
- ○ F. Beli kredit dari…….
- ○ G Rekan kerja atau Keluarga
- ○ V. Lainnya, Mohon jelaskan ……

24 Apakah anda tahu berapa biaya operasional dari usaha tambak tempat anda bekerja ini?

Catatan: biaya operasional yang dimaksud meliputi biaya gaji pegawai, biaya transportasi, biaya bahan baku dan lainnya

- ○ 1 Ya saya tahu, Rp……
- ○ 3 Tidak, saya tidak dilibatkan

25 Berapa sering tambak udang anda ini dipanen?

- ○ A. Sekali setahun
- ○ B. Dua kali setahun
- ○ C. Tiga kali setahun
- ○ D. Empat kali setahun
- ○ V. Lebih dari lima tahun setahun, Mohon jelaskan……
  ……

26 Bisakah anda memperkirakan pendapatan kotor tahunan dari perusahaan tambak tempat anda bekerja ini?

Catatatan: Jika Kurang tahu, berita perkiraan

- ○ 1 Ya
  - ○ a. Kurang dari Rp 25,000,0000
  - ○ b. Rp 25,000,001-Rp 50,000,000
  - ○ c. Rp 50,000,001-Rp 75,000,000
  - ○ d. Rp 75,000,001-Rp 100,000,000
  - ○ e. Rp100,000,001-Rp 125,000,000
  - ○ f. Lebih dari Rp 125,000,000
- ○ 3 No

27 Apakah pendapatan kotor usaha /tambak tempat anda bekerja ini mengalami perubahan dalam enam tahun terakhir ini?

- ○ 1. Ya
- ○ 3. Tidak…….Lihat ke ……31

28 Jika Ya, apakah salah satu diantara daftar berikut ini mempengaruhi perubahan pendapatan tempat anda bekerja?

Catatan: Jika Kurang tahu, berita perkiraan

- ○ A. Munculnya Lumpur Panas di Porong
- ○ B. Kondisi makro ekonomi nasional
- ○ C. Kenaikan harga harga bahan baku
- ○ D. Jatuhnya harga udang
- ○ E. Peraturan/regulasi pemerintah, Mohon jelaskan……
- ○ V. Lainnya, Mohon jelaskan ……..

29 Apakah perubahan ini sangat mempengaruhi secara significant?

- ○ A. Ada perubahan tapi tidak significant
- ○ B. Turun drastis sangat significant, Berapa ……%
- ○ C. Hanya dimusin kemarau , Berapa ……%
- ○ D. Hanya dimusim Hujan, Berapa ……%
- ○ V. Lainnya, Mohon jelaskan ……..

30 Apakah biaya operasional mengalami perubahan dalam enam tahun terakhir?

- ○ 1 Ya
- ○ 3 Tidak Tahu, lihat ke 31

31 Biaya operaional manakah yang paling dipengaruhi

Note: Beritanda skala priorias, 1 sebagai posisi yang paling penting

- ☐ A. Upah dan Gaji
- ☐ B. Bahan Baku
- ☐ C. Cicilan Bank

☐	D.	Peralatan
☐	E.	Pemeliharaan
☐	V.	Lainnya, Mohon jelaskan ……

Profile Pekerja

Pertanyaan berikut ini adalah untuk menggambarkan profile pekerja yang bekerja di Industri Perudangan

32 Berapa jumlah pekerja yang anda pekerjakan dalam tambak udang anda?

……

33 Dari pekerja anda mohon diidentifikasi tempat tinggal dari pekerja anda berdasar dari kriteria berikut ini?

Catatan : Jawaban dapat lebih dari satu:

○	A.	Tinggal di masyarakat yang dekat dengan lokasi tambak……..Orang
○	B.	Di desa lain tapi satu kecamatan.....Orang
○	C.	Didesa lain, dikecamatan lain tapi satu kabupaten,…….. orang
○	D.	Diluar Kabupaten
○	V.	Lainnya

34 Apakah anda memiliki hubungan keluarga dengan pemilik tambak ini?

○	1.	Ya
○	3.	Tidak

35 Apakah ada anggota keluarga anda yang bekerja di tambak ini?

○	1.	Ya , ……Orang
○	3.	Tidak……lihat ke 37

36 Hubungan dengan Anda

Catatatan: Tandai yang relevan

○	A.	Anak
○	B.	Istri
○	C.	Saudaranya Istri
○	D.	Saudara Anda
○	V.	Lainnya, Mohon jelaskan ……

37 Apa alasannya mereka bersedia bekerja di sektor ini bersama anda?

Catatan: bisa dijawab lebih dari satu jawaban

- ○ A. Mereka butuh pekerjaan
- ○ B. Mereka dapat dipercaya
- ○ C. Tidak perlu digaji mahal
- ○ D. Mereka memiliki ketrampilan yang dibutuhkan
- ○ E. Tidak punya pilihan lain
- ○ V. Lainnya, Mohon jelaskan ……..

Pertanyaan pertanyaan berikut ini dimaksudkan untuk menggali rantai pemasaran dari perusahaan tambak udang anda dalam rangka memahami signifikansi atas sektor pertambakan kepada sektor lainnya

38 Apakah anda dilibatkan dalam pemasaran produk perusahaan anda?

○ 1 Ya ○ 3 Tidak, saya tidak dilibatkan, Lihat ke 46

39 Bagian pemasaran/marketing apakah yang menjadi tanggung jawab anda?

- ○ A Menjualnya di masyarakat sekitar
- ○ B Membantu di Pengemasan untuk eksport
- ○ V Lainnya_____

40 Dari daftar berikut ini, pasar manasaja yang biasanya dilayani oleh perusahaan tempat anda bekerja?
Note: Beritanda skala priorias, 1 sebagai posisi yang paling penting

- ☐ 1. Pasar Local (satu desa)
- ☐ 2. Sekitar Sidoarjo
- ☐ 3. Kota kota lain di Propinsi Jawa timur
- ☐ 4. Pasar Indonesia umumnya diluar propinsi jawatimur
- ☐ 5. Eksport ke Luar negeri
- ☐ 95. Lainnya_____

41 Methode pembayaran yang anda gunakan dalam transaksi perusahaan tempat anda bekerja?
Note: Beritanda skala priorias, 1 sebagai posisi yang paling penting

- ☐ A. Pembayaran langsung cash
- ☐ B. Credit
- ☐ V. Lainnya,……..

42 Alat pembayaran yang digunakan
Note: Beritanda skala priorias, 1 sebagai posisi yang paling penting

☐	A.	Cash
☐	B.	Kartu Debit (Debit Card)
☐	C.	Kartu Kredit (Credit Card)
☐	D.	Cheque
☐	E.	Bank Transfer
☐	V.	Lainnya, Mohon jelaskan ……..

43 Berapa persen produk tambak tempat anda bekerja yang dipasarkan di pasar tradisional ?
Catatatan: Tandai satu saja

- ○ A. 1-5%
- ○ B. 6-15%
- ○ C. 16-20%
- ○ D. 21-25%
- ○ E. Lebih dari 25%

44 Berapa prosentasi produksi tambak tempat anda bekerja yang dipasarkan ke Luar negeri
Catatatan: Tandai satu saja

- ○ A. 1-10%
- ○ B. 11-20%
- ○ C. 21-30%
- ○ D. 31-40%
- ○ E. 41-50%
- ○ F. Lebih dari 50%

45 Dari daftar berikut ini jenis produk apakah yang dijual oleh perusahaan tempat anda bekerja kepada pembeli potensial?
Catatatan: Beritanda skala priorias, 1 sebagai posisi yang paling penting

☐	A.	Life Shrimps (udang Hidup)
☐	B.	HOSO (Head On Shell On)
☐	C.	HLSO (Head Less Shell On)
☐	D.	PD (Peel Devine)
☐	V.	Lainnya, Mohon jelaskan……..

46 Bagaimana anda mengirim hasil panen tambak tempat anda bekerja ke pasar?

- ○ A. Diambil langsung oleh Pembeli
- ○ B. Kami mengirimnya depot dengan kendaraan sendiri
- ○ C. Mengunakan jasa pengiriman
- ○ D. Semua pengiriman di koordinasikan oleh assosiasi petani tambak
- ○ V. Lainnya, Mohon jelaskan……..

47 Seberapa pentingkan pasar berikut ini menurut prespektif anda

			Very Important ⇒⇒Less Important				
			1	2	3	4	5
?	A.	Export	○	○	○	○	○
	B.	Restaurants	○	○	○	○	○
	C.	Perusahaan Krupuk Udang(Shrimp Crackers)	○	○	○	○	○
	D.	Perusahaan Petis udang (Shrimp Paste)	○	○	○	○	○
?	E.	Perusahaan makanan kecil (Shrimp Nibles)	○	○	○	○	○
	F.	Perusahaan pengexport udang	○	○	○	○	○
	G	Pasar Traditional	○	○	○	○	○
?	V.	Lainnya, Mohon jelaskan……..	○	○	○	○	○

c. Perubahan operasional Pengelolaan Tambak

Bagian ini bertujuan untuk mengali informasi tentang proses produksi udang sebelum dan sesudah munculnya bencana lumpur panas di Porong.

48 Dimanakah perusahaan tambak anda memperoleh bahan bahan budidaya udang berikut ini ?

Bibit Udang		Pakan Udang		Peralatan pertambakan	
○ A.	Menangkap/menyarikan dari laut lepas	○ A.	Dijadwal oleh assosiasi petambak	○ A.	Membuat dan merakit sendiri
○ B.	Dari agen yang disarankan oleh Petugas Penyuluh Pertanian	○ B.	Dijadwal oleh Petugas Penyuluh Pertanian	○ B.	Dibantu pengadaan dan perakitannya oleh Petugas Penyuluh Pertanian
○ C.	Disuply oleh depot	○ C.	Pesan langsung dari toko berdasarkan kebutuhan	○ C.	Disediakan oleh depot
○ D.	Disuply oleh pembeli	○ D.	Dipesankan oleh assosiasi petani berdasarkan kebutuhan	○ D.	Disediakan oleh pembeli
○ E.	Dibeli dari hatchery	○ E.	Disediakan oleh pembeli	○ E.	Diberli dari koto
○ V.	Lainnya, Mohon jelaskan…… ……	○ V.	Lainnya, Mohon jelaskan …… ……..	○ V.	Lainnya, Mohon jelaskan…… …… …

49 Metode pengiriman bahan baku budidaya udang

Bibit Udang	Pakan Udang	Peralatan pertambakan
○ A. Dikirim oleh penjual	○ A. Dikirim oleh penjual	○ A. Dikirim oleh penjual
○ B. Mengambil dari toko sendiri	○ B. Mengambil dari toko sendiri	○ B. Mengambil dari toko sendiri
○ C. Menggunakan jasa pengiriman	○ C. Menggunakan jasa pengiriman	○ C. Menggunakan jasa pengiriman
○ D. Dikoordinasikan oleh paguyupan	○ D. Dikoordinasikan oleh paguyupan	○ D. Dikoordinasikan oleh paguyupan
○ V. Lainnya, Mohon jelaskan……	○ V. Lainnya, Mohon jelaskan……..	○ V. Lainnya, Mohon jelaskan……

50 Dalam enam tahun terakhir, apakah ada perubahan dalam mendapatkan bahan baku budidaya udang?

○ A. Ya , Jelaskan perubahan yang dimaksud……
……

○ B. Tidak……go to 53

51 Dari daftar berikut ini , faktor apa saja yang mempengaruhi perubahan menyediaan / ketersediaan bahan baku budidaya udang?
Note: bisa dijawab lebih dari satu jawaban

○ A. Munculnya Lumpur Panas di Porong
○ B. Kondisi perekonomian makro nasional
○ C. Harga bahan makanan udang
○ D. Harga udang turun
○ E. Regulasi Pemerintah, Mohon jelaskan……
○ V. Lainnya, Mohon jelaskan ……..

52 Kesulitan bahan baku ini muncul kapan?

○ A. Sebelum 29 Mai 2006
○ B. Sesudah 29 Mai 2006
○ V. Lainnya, Mohon jelaskan…….

53 Bagaimana perubahan pada level produski

○ A. Sudden drop
○ B. sudden death
○ c sudden stock loss
○ V. Lainnya, Mohon jelaskan…….

54 Dalam enam tahun terakhir, apakah tambak udang dimana anda bekerja mengalami perubahan metode budidaya yang dilakukan?

○ 1. Ya
○ 3. Tidak…….Lihat ke 76

55 Dari daftar berikut ini apakah mempengaruhi level produksi

			Sangat Penting ⇒⇒Kurang Penting				
			1	2	3	4	5
	A.	Munculnya lumpur panas di porong	○	○	○	○	○
	B.	Kondisi ekonomi makro nasional	○	○	○	○	○
	C.	Harga makanan udang	○	○	○	○	○
	D.	Harga jual udang rendah	○	○	○	○	○
	E.	Peraturan Pemerintah, Mohon jelaskan…….	○	○	○	○	○
	V.	Lainnya, Mohon jelaskan ……..	○	○	○	○	○

56 Apakah anda mempraktekkan teknik dan metode khusus dalam budidaya udang khususnya terkait masalah penurunan kualitas air yang kemungkinan diakibatkan oleh adanya bencana lumpur panas di Porong?

○ 1 Ya Mohon jelaskan.....

○ 3 Tidak

57 Apakah ada kearifan lokal atau tradisi yang menginspirasi teknik budadaya udang yang anda lakukan?

○ 1 Ya Mohon jelaskan.....
.....

○ 3 Tidak

58 Apakah pemberi kerja anda mendorong dan mendukung pengembangan teknik budidaya udang yang baru?

○ 1 Ya , berupa apakah dukungan tersebut? ……..
……..

○ 3 Tidak

59 Apakah saat ada dukungan pemerintah untuk meningkatkan kualitas panen?

○ 1 Ya

○ 3 Tidak, liat ke 61

60 Manakah dari daftar program pemerintah berikut ini yang paling dibutuhkan untuk meningkatkan kualitas panen?

Note: Beritanda skala priorias, 1 sebagai posisi yang paling penting

☐	A.	Bantuan Teknik
☐	B.	Bantuan Keuangan
☐	C.	Membantu proses pasca panen / bantuan pemasaran
☐	D.	Mengenalkan contoh ideal
☐	V.	Lainnya, Mohon jelaskan.....

61 Dari daftar lembaga berikut ini bagaimana derajat kegunaan dalam mendukung peningkatan produktifitas udang?

		Sangat Penting ⇒⇒Kurang Penting				
		1	2	3	4	5
A.	Pusat/Lembaga Penelitian Perguruan Tinggi	○	○	○	○	○
B.	Lembaga Penelitian Komersial	○	○	○	○	○
C.	Lembaga Penelitian perusahaan Exporter	○	○	○	○	○
D.	Penelitian mandiri dari masyarakat	○	○	○	○	○
V.	Lainnya, Mohon jelaskan……	○	○	○	○	○

62 Jika anda memiliki dukungan yang memadai misalkan mendapatkan pelatihan apakah ada mau merubah teknik budidaya udang yang anda lakukan?

○ 1. Ya
○ 3. Tidak, Konsekwensi apa yang mungkin anda terima……Lihat ke 76

63 Jika Ya , apakah alasan anda untuk merubah metode budidaya anda?
Catatan: bisa dijawab lebih dari satu jawaban

○ A. Meningkatkan produktifitas, sampai……..%
○ B. Mengurangi resiko kegagalan panen
○ C. Mengikuti kawan kawan petambak lainnya
○ D. Untuk mendapatkan insentive yang ditawarkan
○ V. Lainnya, Mohon jelaskan ……..

64 Metode apakah yang anda terapkan untuk menjaga kualitas air yang digunakan?

○ A. Menanam pohon mangroves disekitar tambak
○ B. Mengunakan penyaring air
○ C. Tidak melakukan apa apa
○ D. Menggunakan bibit unggul
○ E. Lainnya, Mohon jelaskan……

65 Apakah ada bantuan dari luar masyarakat dalam penanggulangan polusi?
Note: if ya , bisa dijawab lebih dari satu jawaban

○ 1 Ya

○	A	Lembaga Pemerintah
○	B	Perusahaan (bagian dari program CSR)
○	C	NGO/LSM
○	D	Perusahaan pengesxport udang
○	E	Lainnya, Mohon jelaskan…… …… ……

○ 3 Tidak ada, lihat ke 68

66 Dari bantuan yang berasal dari luar masyarakat berikut ini, bantuan yang bagaimana yang paling dibutuhkan di menanggulangan polusi dan atau peningkatan kualitas panen?
Catatan: Beritanda skala priorias, 1 sebagai posisi yang paling penting

☐	A.	Bantuan Teknik
☐	B.	Bantuan Pembiayaan
☐	C.	Memfasilitasi proses pasca panen/ bantuan pemasaran
☐	D.	Mengenalkan model baru
☐	V.	Lainnya, Mohon jelaskan……

67 Berapa lama bantuan tersebut anda terima?

○ A. Kurang dari 1 bulan

B. 1-3 bulan
C. 4-6 Bulan
D. Satu tahun
E. Lebih dari satu tahun

68 Inisiatif apasaja yang telah anda lakukan sendiri dalam rangka mengurangi polusi dan meningkatkan kualitas panen?

A. Melakukan percobaan sendiri
B. Melakukan dengan asosiasi petani
C. Mencari masukan dan nasehat dari petani lain atau assosiasi petani udang diluar kabupaten sidoarjo
D. Mencari masukan dan nasehat dari petani lain atau assosiasi petani udang diluar kabupaten sidoarjo
E. Lainnnya, Mohon jelaskan.....

c. Perubahan yang terjadi terkait dengan Lumpur Panas Porong

Bagian ini ingin menggambarkan pandangan petani udang atas kemunculan Lumpur panas di Porong

Catatan: SS= Sangat Setuju, S= Setuju, N=nentral, STS= Sangat Tidak setuju

No	Pernyataan	No	Pilihan Jawaban				
			SS	S	N	TS	STS
1	Apakah anda sadar bila bencana lumpur panas di porong mempengaruhi kehidupan sosial anda?	1					
2	Apakah hubungan anda dengan pekerja tambak udang udang lainnya berubah semenjak munculnya lumpur panas di Porong?	2					
3	Sebagai pekerja tambak udang, apakah pola komunikasi anda dengan komunitas sekitar berubah semenjak munculnya lumpur panas di Porong?	3					
4	Apakah komunikasi dengan assosiasi petani udang effective?	4					
5	Dalam rangka mengantisipasi terhadap dampak lumpur panas di Porong apakah anda menerapkan teknik baru dalam budidaya udang?	5					
6	Apakah perusahaan dimana anda bekerja mendapatkan bantuan dari pemerintah?	6					
7	Apakah bank atau lembaga keuangan juga dibutuhkan dalam rangka membantu penyelesaian masalah yang dihadapi petani Udang?	7					
8	Apakah dukungan masyarakat sekitar dibutuhkan untuk menyelesaiakan masalah yang dihadapi petani udang?	8					
9	Apakah dukungan perusahaan pengexport udang dibutuhkan menyelesaiakan masalah yang dihadapi petani udang?	9					
10	Apakah anda merasa lebih beruntung dibanding dengan petani udang lainnya?	10					
11	Apakah anda perlu merubah usaha inti anda?	11					
12	Menurut anda , Apakah pemerintah harus memberi bantuan kepada anda?	12					

13	Menurut anda , Apakah PT Lapindo harus memberi bantuan kepada anda?	13	○	○	○	○	○

Apakah anda berusia 18 tahun atau lebih?, Apakah anda saat ini adalah pemilik tambak udang yang berada disalah satu wilayah berikut ini? : Gebang, Sekardangan (Kec. Sidoarjo), Kedung Peluk (Kec. Candi), BanjarPanji, Banjar Asri, Penatar Sewu (Kec. Tanggulangin) Plumbon (Kec. Porong), Permisan, Tambak Kalisogo, Kupang, Kedung Pandan (Kec. Jabon), Sawohan (Kec. Buduran), Kalanganyar, Tambak Cemandi, Banjar Kemuning (Kec. Sedati) and Tambak Sawah (Kec. Waru)

Jika iya, kami berharap anda bersedia berpartisipasi dalam survey ini.

Survey ini berusaha menggali informasi tentang respon petani udang, pemerintah dan pihak terkait atas terjadinya bencan lumpur vulkanik di Porang pada wilayah tertentu yang menjadi target penelitian. Survey ini terfokuskan pada: tingkat kontaminasi dan gangguan yang dialami petambak udang atas munculnya Lumpur panas di Porong; dampak sosial-ekonomi dari gangguan yang muncul terhadap produksi tambak udang; metode dan tekhnik yang dilakukan oleh petambak udang dalam menyikapi potensi ancaman yang muncul; peranan pemerintah dalam dukungannya kepada petambak udang dalam menanggulangi potensi polusi; sejauh mana dukungan pemerintah terhadap usaha yang terdampak; sejauhmana innovasi yang dilakukan oleh petani udang di Sidoarjo bisa diadopsi di daerah lain di Indonesia.

Survey ini memakan waktu 60 menit. Nama dan identitas anda akan dirahasiakan dalam survey ini

Survey ini dipersiapkan oleh Achmad Room Fitrianto sebagai bagian dari penelitian yang bersangkutan untuk memperoleh gelar PhD Pada The School of Social Science and Asian Languages Curtin University, Perth. Judul PhD thesis yang diajukan adalah “The socio-economic impacts of the Porong mud flow on the shrimp fisheries sector in Sidoarjo District, East Java Province Indonesia". Penelitian ini dibawah bimbingan Prof. Dr. Bob Pokrant dan Dr. Aileen Hoath dari Curtin University.

Penelitian ini akan menyelidiki setiap dampak dari bahaya yang disebabkan manusia atau alam yang mempengaruhi kondisi sosial ekonomi dari Industri udang. Dengan menggambarkan berbagai kerentanan yang berpotensi terjadi di komunitas, penelitian ini akan membantu mengidentifikasi sumber utama kerentanan dan kelompok-kelompok lokal tertentu yang paling terpengaruh oleh mereka, dengan cara ini masyarakat akan berada dalam posisi yang lebih baik untuk menanggapi keprihatinan dengan cepat dan juga merencanakan untuk segala kemungkinan di masa depan.

Penelitian doktoral ini didukung oleh Kementerian Pendidikan dan Kebudayaan, Direktorat Pendidikan Tinggi Indonesia dibawah program beasiswa DIKTI Bench 5

Penelitian ini sudah sesuai dengan prosedur ethic dari Curtin University. Semua data yang dikumpulkan sesuai dengan pedoman penelitian perguruan tinggi untuk melindungi anonimitas masing-masing narasumber atau obyek penelitian. Setiap publikasi yang dihimpun dari survey ini akan dicantumkan sebagai informasi

Kesediaan anda untuk mengisi survey ini akan dipahami sebagai bentuk kesediaan anda dalam berpartisipasi dalam penelitian ini dan kesediaan untuk mengijinkan mengunakan informasi yang anda berikan untuk kepentingan ilmiah penelitian ini

Untuk Keterangan lebih lanjut tentang penelitian ini, tujuan penelitian anda dapat menghubungi Achmad Room Fitrianto

Achmad Room Fitrianto
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IAIN Sunan Ampel- Surabaya
email: ar.fitrianto@sunan-ampel.ac.id
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No. Questionnaire :		**Tanggal :**			
No. Desa :		**No. Kecamatan :**			

Silahkan beri tanda silang atau centang salah satu pilihan jawaban berikut ini

a. **Data demografi dasar**

Bagian berikut ini akan menampilkan profil dari responden penelitian ini.

1 Apakah gender anda?

○ a. Laki Laki ○ b. Perempuan

2 Berapakah usia anda?

○ a.18-25 ○ c. 46-65

○ b.26-45 ○ d. 66+

2 Latar pendidikan/ pendidikan tertinggi yang dicapai

○ a. SD ○ b. SMA

○ c. SMP ○ d. Perguruan Tinggi

○ e. Lainnya, Mohon jelaskan……

……

3 Berapa lama anda menekuni budidaya udang ini?

○ a. Kurang dari setahun ○ c. 5-10

○ b. 1 -5 Tahun ○ d. >10 Tahun

Data Rumah Tangga

4 Berapa anggota keluarga anda yang tinggal serumah dengan anda?

○ a.2-4 orang ○ c.7-9 Orang

○ b.5-6 orang ○ d. Lebih dari 10 orang

Silahkan isi tabel berikut ini dari anggota keluarga anda tersebut

No.	Nama (inisial)	Hubungan dengan resonden	Gender		usia	Tingkat Pendidikan	Pekerjaan Saat ini
1.			L	P			
2.			L	P			
3.			L	P			
4.			L	P			
5.			L	P			
6.			L	P			
7.			L	P			

5. Apakah ada diantara anak anda atau anggota keluarga yang lain yang bekerja di sektor pertambakan yang sama dengan anda?

   ○ a. Ya, Sektor dan perusahaan yang sama
   ○ b. Ya, Tapi beda perusahaan
   ○ c. Tidak

6. Berapa perkiraan total pendapatan anda dari usaha tambak udang?

   ○ a. Rp 100,000-Rp 500,0000
   ○ b. Rp 500,001-Rp 1000,000
   ○ c. Rp 1,000,001-Rp 1,500,000
   ○ d. Rp 1,500,001-Rp 2,000,000
   ○ e. Rp2,000,001-Rp 2,500,000
   ○ f. Lebih dari Rp 2,500,000

7 Bagaimana cara anda membayar pekerja anda?
Catatan: bisa dijawab lebih dari satu jawaban

   ○ A. Mingguan
   ○ B. Bulanan
   ○ C. Komisi, berapa persen?
   ○ D. Bagi hasil
   ○ **V. Lainnya, Mohon jelaskan …….**

8 Berapa perkiraan pengeluaran rumah tangga anda perbulan?

   ○ a. Rp 100,000-Rp 500,0000
   ○ b. Rp 500,001-Rp 1000,000
   ○ c. Rp 1,000,001-Rp 1,500,000
   ○ d. Rp 1,500,001-Rp 2,000,000
   ○ e. Rp2,000,001-Rp 2,500,000
   ○ f. Lebih dari Rp 2,500,000

b. Profile Usaha

Pertanyaan pertanyaan berikut ini akan berusaha mencari gambaran tentang struktur organisasi pertambakan dan skala ekonominya. Pada bagian ini akan ditanyakan dua pertanyaan penting, pertama adalah kondisi tambak, kedua adalah struktur usaha termasuk didalamnya nilai usaha dan para pekerjanya

9. Dari daftar tabel berikut ini mana yang paling dekat dengan menggambaran tambak anda? Tolong beri tanda silang atau centang yang menggambarkan kondisi tambak anda!

Catatan: bisa dijawab lebih dari satu jawaban

Jenis	Methode Budidaya	Jenis Budidaya	Sarana
○ a.Tambak	○ a. Traditional ○ b. Semi intensive ○ c. Intensive ○ d. Organik ○ e. Lainnya, Mohon jelaskan…… …… ……	○ 1.Udang ○ 2. Bandeng ○ 3. udang dan bandeng ○ 4. Udang, bandeng dan Lainnya ○ 5. Pemrosesan ○ 99. Lainnya Mohon jelaskan…… … ……	○ a. Airpayau ○ b. Airpayau (yang diambil /dikombinasi dari sungai terdekat) ○ c. Airtawar ○ d. Air Tawar (berasal dari sungai terdekat) ○ e. Air Asin (laut) ○ f. Lainnya, Mohon jelaskan…… ……

Jenis	Methode Budidaya	Jenis Budidaya	Sarana
○ b.Kolam	○ a. Traditional ○ b. Semi intensive ○ c. Intensive ○ d. Organik ○ e. Lainnya, Mohon jelaskan…… …… ……	○ 1.Udang ○ 2. Bandeng ○ 3. Udang dan bandeng ○ 4. Udang, bandeng dan Lainnya ○ 5. Pemrosesan ○ 99. Lainnya Mohon jelaskan…… … ……	○ a. Airpayau ○ b. Airpayau (yang diambil /dikombinasi dari sungai terdekat) ○ c. Airtawar ○ d. Air Tawar (berasal dari sungai terdekat) ○ e. Air Asin (laut) ○ f. Lainnya, Mohon jelaskan……

		……

10 Sejak kapan tambak anda ini beroperasi?

- ○ Tanggal/Bulan/Tahun: ……/……/……..
- ○ Kurang tahu

11 Dilokasi tambak ini apakah selalu membududayakan ikan atau udang? (sebelum jadi tambak berupa apa?)

- ○ 1. Ya
- ○ 3. Tidak, Lihat ke 13

12 Jika sebelumnya bukan berupa tambak ikan atau udang, berupa apakah?
Catatan: bisa dijawab lebih dari satu jawaban

- ○ A. Sawah/Pagi
- ○ B. Mangrove
- ○ C. Rawa
- ○ D. Padang Rumput
- ○ V. Lainnya, Mohon jelaskan……

13 Apakah anda punya ijin usaha? Jika Ya, dalam bentuk apakah ijin usaha tersebut dan bagaimana status kepemilikian usaha pertambakan yang anda miliki?

○ 1 Ya

Jenis Perusahaan	Tanggal berdiri	Status Kepemilikan
○ 1 Perseroan Terbatas/PT	(……../……../……..)	○ 1 Milik Individu
○ 2 Commendatory (CV)	(……../……../……..)	○ 2 Sewa
○ 3 Perusahaan dagang	(……../……../……..)	○ 3 Mengunakan dengan Cuma Cuma
○ 99 Lainnya, Mohon jelaskan…… …… …… .	(……../……../……..)	○ 99 Lainnya, Mohon jelaskan…… …… …… ……..

○ 3 Tidak memiliki ijin usaha

14 Berapakah luas area yang anda gunakan dalam usaha ini?

- ○ a. Tanah: ……M2
- ○ b. Bangunan……M2

15 Berapakah perkiraan nilai total aset perusahaan anda?
Rp:……

16 Apakah perusahan anda sudah memiliki TDP (Tanda Daftar Perusahaan)

- ○ 1.Ya , sejak ……/……/……..
- ○ 3.Tidak …….Lihat ke 28

19 Apakah anda memiliki NPWP (Nomor Pokok Wajib Pajak)?

- ○ 1.Ya , sejak kapan ……/……/……..
- ○ 3.Tidak…….Lihat ke 21

20 Atas nama siapakah NPWP ini?
Catatatan: Jawaban dapat lebih dari satu

- ○ A. Atas naman Pribadi
- ○ B. Atas Nama Perusahaan
- ○ V. Lainnya, Mohon jelaskan……

21 Apakah anda mengunakan aplikasi akuntansi berikut ini?

○	1.	Catatan Penasukan atau Catatan belanja perusahaan	○ 1	Ya	○ 3	No
○	2.	Jurnal Harian	○ 1	Ya	○ 3	No
○	3.	Jurnal Rugi Laba	○ 1	Ya	○ 3	No
○	4.	Jurnal pendapatan	○ 1	Ya	○ 3	No
○	95.	Lainnya_____	○ 1	Ya	○ 3	No

22 Bisakah anda memperkirakan modal awal dalam memulai usaha ini?
Catatan: modal awal yang dimaksud selain tanah dan bangunan

○ 1 Ya

- ○ a. Kurang dari Rp 2,500,0000
- ○ b. Rp 2500,001-Rp 5000,000
- ○ c. Rp 5,000,001-Rp 7,500,000
- ○ d. Rp 7,500,001-Rp 10,000,000
- ○ e. Rp10,000,001-Rp 12,500,000
- ○ f. Lebih dari Rp 12,500,000

○ 3 Tidak

23 Apakah modal yang anda peroleh dalam menjalankan usaha ini akan digunakan untuk membiayai beberapa keperluan berikut ini?
Catatatan: Beritanda skala priorias, 1 sebagai posisi yang paling penting

- ☐ A. Menyewa tambak dilokasi lain
- ☐ B. Untuk membeli pakan udang
- ☐ C. Untuk membayar gaji pekerja
- ☐ D. Untuk membeli mesin, Mohon jelaskan……
- ☐ E. Untuk Gaji Konsultan
- ☐ F. Untuk memulai usaha baru, Mohon jelaskan……..
- ☐ V. Lainnya, Mohon jelaskan ……

24 Dari daftar berikut ini, mana yang menjadi salah satu sumber pembiayaan usaha anda?
Catatan: Beri tanda semua jawaban yang sesuai (bisa lebih dari 1 jawaban)

- ○ A. Bank,……(Nama Bank)
- ○ B. Lembaga Keuangan Mikro,……(Nama Lembaga)
- ○ C. Pegadaian
- ○ D. Rentenir
- ○ E. Bantuan Pemerintah
- ○ F. Beli kredit dari……
- ○ G Rekan kerja atau Keluarga
- ○ V. Lainnya, Mohon jelaskan ……

25 Apakah anda tahu berapa biaya operasional dari usaha tambak ini?

Catatan: biaya operasional yang dimaksud meliputi biaya gaji pegawai, biaya transportasi, biaya bahan baku dan lainnya

- ○ 1 Ya saya tahu, Rp……
- ○ 3 Tidak, saya tidak dilibatkan

26 Berapa sering tambak udang anda ini dipanen?

- ○ A. Sekali setahun
- ○ B. Dua kali setahun
- ○ C. Tiga kali setahun
- ○ D. Empat kali setahun
- ○ V. Lebih dari lima tahun setahun, Mohon jelaskan……
  ……

27 Bisakah anda memperkirakan pendapatan kotor tahunan dari perusahaan tambak anda ini?
Catatatan: Jika Kurang tahu, berita perkiraan

- ○ 1 Ya
  - ○ a. Kurang dari Rp 25,000,0000
  - ○ b. Rp 25,000,001-Rp 50,000,000
  - ○ c. Rp 50,000,001-Rp 75,000,000
  - ○ d. Rp 75,000,001-Rp 100,000,000
  - ○ e. Rp100,000,001-Rp 125,000,000
  - ○ f. Lebih dari Rp 125,000,000
- ○ 3 Tidak

28 Apakah pendapatan kotor usaha anda ini mengalami perubahan dalam enam tahun terakhir ini?

- ○ 1. Ya
- ○ 3. Tidak…….Lihat ke 31

29 Jika Ya, apakah salah satu diantara daftar berikut ini mempengaruhi perubahan pendapatan anda?
Catatatan: bisa dijawab lebih dari satu jawaban

- ○ A. Munculnya Lumpur Panas di Porong
- ○ B. Kondisi makro ekonomi nasional
- ○ C. Kenaikan harga harga bahan baku
- ○ D. Jatuhnya harga udang
- ○ E. Peraturan/regulasi pemerintah, Mohon jelaskan……
- ○ V. Lainnya, Mohon jelaskan ……

30 Apakah perubahan ini sangat mempengaruhi secara significant?

- ○ A. Ada perubahan tapi tidak significant
- ○ B. Turun drastis sangat significant, Berapa ……%
- ○ C. Hanya dimusin kemarau , Berapa ……%
- ○ D. Hanya dimusim Hujan, Berapa ……%
- ○ V. Lainnya, Mohon jelaskan ……

31 Apakah biaya operasional mengalami perubahan dalam enam tahun terakhir?

- ○ 1 Ya
- ○ 3 Tidak Tahu, Lihat ke 33

32 Biaya operaional manakah yang paling dipengaruhi
Catatatan: Beritanda skala priorias, 1 sebagai posisi yang paling penting

- ☐ A. Upah dan Gaji
- ☐ B. Bahan Baku
- ☐ C. Cicilan Bank
- ☐ D. Peralatan
- ☐ E. Pemeliharaan
- ☐ V. Lainnya, Mohon jelaskan ……

Profile Pekerja

Pertanyaan berikut ini adalah untuk menggambarkan profile pekerja yang bekerja di Industri Perudangan

33 Berapa jumlah pekerja yang anda pekerjakan dalam tambak udang anda?

……

34 Dari pekerja anda mohon diidentifikasi tempat tinggal dari pekerja anda berdasar dari kriteria berikut ini?

Catatan : Jawaban dapat lebih dari satu:

- ○ A. Tinggal di masyarakat yang dekat dengan lokasi tambak, …….Orang.
- ○ B. Di desa lain tapi satu kecamatan,…….Orang
- ○ C. Didesa lain, dikecamatan lain tapi satu kabupaten, ……..Orang
- ○ D. Diluar Kabupaten,……..Orang
- ○ V. Lainnya, Mohon jelaskan ……..

35 Apakah ada anggota keluarga anda yang bekerja di tambak ini?

- ○ 1. Ya, ……orang
- ○ 3. Tidak ……Lihat ke 38

36 Hubungan dengan anda?

Catatatan: Tandai yang relevan

- ○ A. Anak
- ○ B. Istri
- ○ C. Saudaranya Istri
- ○ D. Saudara Anda
- ○ V. Lainnya, Mohon jelaskan ……..

37 Jika iya, apakah alasan mereka bekerja pada anda?

Catatan: bisa dijawab lebih dari satu jawaban

- ○ A. Mereka butuh pekerjaan
- ○ B. Mereka dapat dipercaya
- ○ C. Tidak perlu digaji mahal
- ○ D. Mereka memiliki ketrampilan yang dibutuhkan
- ○ E. Tidak punya pilihan lain
- ○ V. Lainnya, Mohon jelaskan ……..

Pertanyaan pertanyaan berikut ini dimaksudkan untuk menggali rantai pemasaran dari perusahaan tambak udang anda dalam rangka memahami signifikansi atas sektor pertambakan kepada sektor lainnya

39 Apakah anda terlibat dalam pemasaran produk perusahaan anda?

○ 1 Ya ○ 3 Tidak, saya tidak dilibatkan, Lihat ke 41

40 Bagian pemasaran/marketing apakah yang menjadi tanggung jawab anda?

- ○ A Menjualnya di masyarakat sekitar
- ○ B Membantu di Pengemasan untuk eksport
- ○ V Lainnya_____

41 Dari daftar berikut ini, pasar manasaja yang biasanya dilayani oleh perusahaan anda?
Catatatan: Beritanda skala priorias, 1 sebagai posisi yang paling penting

- ☐ 1. Pasar Local (satu desa)
- ☐ 2. Sekitar Sidoarjo
- ☐ 3. Kota kota lain di Propinsi Jawa timur
- ☐ 4. Pasar Indonesia umumnya diluar propinsi jawatimur
- ☐ 5. Eksport ke Luar negeri
- ☐ 95. Lainnya_____

42 Methode pembayaran yang anda gunakan dalam transaksi perusahaan anda?
Catatatan: Beritanda skala priorias, 1 sebagai posisi yang paling penting

- ☐ A. Pembayaran langsung cash
- ☐ B. Credit
- ☐ V. Lainnya,……..

43 Alat pembayaran yang digunakan
Catatatan: Beritanda skala priorias, 1 sebagai posisi yang paling penting

☐	A.	Cash
☐	B.	Kartu debit (Debit Card)
☐	C.	Kartu Kredit (Credit Card)
☐	D.	Cheque
☐	E.	Bank Transfer
☐	V.	Lainnya, Mohon jelaskan ……..

44 Berapa persen produk anda yang dipasarkan di pasar tradisional ?
Catatatan: Tandai satu saja

- ○ A. 1-5%
- ○ B. 6-15%
- ○ C. 16-20%
- ○ D. 21-25%
- ○ E. Lebih dari 25%

45 Berapa prosentasi produksi anda yang dipasarkan ke Luar negeri
Catatatan: Tandai satu saja

- ○ A. 1-10%
- ○ B. 11-20%
- ○ C. 21-30%
- ○ D. 31-40%
- ○ E. 41-50%
- ○ F. Lebih dari 50%

46 Dari daftar berikut ini jenis produk apakah yang dijual oleh perusahaan anda kepada pembeli potensial?
Catatatan: Beritanda skala priorias, 1 sebagai posisi yang paling penting

☐	A.	Life Shrimps (udang Hidup)
☐	B.	HOSO (Head On Shell On)
☐	C.	HLSO (Head Less Shell On)
☐	D.	PD (Peel Devine)
☐	V.	Lainnya, Mohon jelaskan……..

47 Bagaimana anda mengirim hasil panen tambak anda ke pasar?

- ○ A. Diambil langsung oleh Pembeli
- ○ B. Kami mengirimnya depot dengan kendaraan sendiri
- ○ C. Mengunakan jasa pengiriman
- ○ D. Semua pengiriman di koordinasikan oleh assosiasi petani tambak
- ○ V. Lainnya, Mohon jelaskan……..

48 Seberapa pentingkan pasar berikut ini menurut prespektif anda

			Sangat Penting ⇒⇒Kurang Penting				
			1	2	3	4	5
☐	A.	Export	○	○	○	○	○
	B.	Restaurants	○	○	○	○	○
	C.	Perusahaan Krupuk Udang(Shrimp Crackers)	○	○	○	○	○
	D.	Perusahaan Petis udang (Shrimp Paste)	○	○	○	○	○
☐	E.	Perusahaan makanan kecil (Shrimp Nibles)	○	○	○	○	○
	F.	Perusahaan pengexport udang	○	○	○	○	○
	G	Pasar Traditional	○	○	○	○	○
☐	V.	Lainnya, Mohon jelaskan……..	○	○	○	○	○

c. Perubahan operasional Pengelolaan Tambak

Bagian ini bertujuan untuk mengali informasi tentang proses produksi udang sebelum dan sesudah munculnya bencana lumpur panas di Porong.

49 Dimanakah perusahaan tambak anda memperoleh bahan bahan budidaya udang berikut ini ?

Bibit Udang			Pakan Udang			Peralatan pertambakan		
○	A.	Menangkap/menyaring dari laut lepas	○	A.	Dijadwal oleh assosiasi petambak	○	A.	Membuat dan merakit sendiri
○	B.	Dari agen yang disarankan oleh Petugas Penyuluh Pertanian	○	B.	Dijadwal oleh Petugas Penyuluh Pertanian	○	B.	Dibantu pengadaan dan perakitannya oleh Petugas Penyuluh Pertanian
○	C.	Disuply oleh depot	○	C.	Pesan langsung dari toko berdasarkan kebutuhan	○	C.	Disediakan oleh depot
○	D.	Disuply oleh pembeli	○	D.	Dipesankan oleh assosiasi petani berdasarkan kebutuhan	○	D.	Disediakan oleh pembeli
○	E.	Dibeli dari hatchery	○	E.	Disediakan oleh pembeli	○	E.	Diberli dari koto
○	V.	Lainnya, Mohon jelaskan…… ……	○	V.	Lainnya, Mohon jelaskan …… ……..	○	V.	Lainnya, Mohon jelaskan…… …… …

50 Metode pengiriman bahan baku budidaya udang

Bibit Udang	Pakan Udang	Peralatan pertambakan
○ A. Dikirim oleh penjual	○ A. Dikirim oleh penjual	○ A. Dikirim oleh penjual
○ B. Mengambil dari toko sendiri	○ B. Mengambil dari toko sendiri	○ B. Mengambil dari toko sendiri
○ C. Menggunakan jasa pengiriman	○ C. Menggunakan jasa pengiriman	○ C. Menggunakan jasa pengiriman
○ D. Dikoordinasikan oleh paguyupan	○ D. Dikoordinasikan oleh paguyupan	○ D. Dikoordinasikan oleh paguyupan
○ V. Lainnya, Mohon jelaskan……..	○ V. Lainnya, Mohon jelaskan……..	○ V. Lainnya, Mohon jelaskan……..

51 Dalam enam tahun terakhir, apakah ada perubahan dalam mendapatkan bahan baku budidaya udang?

○ A. Ya, Jelaskan perubahan yang dimaksud ……
……

○ B. Tidak……Lihat ke 55

52 Dari daftar berikut ini , faktor apa saja yang mempengaruhi perubahan menyediaan / ketersediaan bahan baku budidaya udang?
Catatatan: bisa dijawab lebih dari satu jawaban

○ A. Munculnya Lumpur Panas di Porong
○ B. Kondisi perekonomian makro nasional
○ C. Harga bahan makanan udang
○ D. Harga udang turun
○ E. Regulasi Pemerintah, Mohon jelaskan……
○ V. Lainnya, Mohon jelaskan ……..

53 Kapan berubahan itu muncul?

○ A. Sebelum 29 Mai 2006
○ B. Sesudah 29 Mai 2006
○ V. Lainnya, Mohon jelaskan…….

54 Is has there been change in production level (suddent drop in production / death)

○ A. Sudden drop
○ B. Sudden death
○ c sudden stock loss
○ V. Lainnya, Mohon jelaskan…….

55 Dalam enam tahun terakhir, apakah tambak udang dimana anda bekerja mengalami perubahan metode budidaya yang dilakukan?

○ 1. Ya
○ 3. Tidak

56 Dari daftar berikut ini apakah mempengaruhi level produksi

			Sangat Penting ⇒⇒Kurang Penting				
			1	2	3	4	5
	A.	Munculnya lumpur panas di porong	○	○	○	○	○
	B.	Kondisi ekonomi makro nasional	○	○	○	○	○
	C.	Harga makanan udang	○	○	○	○	○
	D.	Harga jual udang rendah	○	○	○	○	○
	E.	Peraturan pemerintah, Mohon jelaskan…….	○	○	○	○	○
	V.	Lainnya, Mohon jelaskan ……..	○	○	○	○	○

58 Apakah anda mempraktekkan teknik dan metode khusus dalam budidaya udang khususnya terkait masalah penurunan kualitas air yang kemungkinan diakibatkan oleh adanya bencana lumpur panas di Porong??

○ 1 Ya Mohon jelaskan.....

○ 3 No

59 Do any local wisdoms or traditions inspire your cultivation techniques

○ 1 Ya Mohon jelaskan.....
.....

○ 3 No

60 Apakah saat ada dukungan pemerintah untuk meningkatkan kualitas panen?

○ 1 Ya

○ 3 Tidak, Liat ke 63

61 Manakah dari daftar program pemerintah berikut ini yang paling dibutuhkan untuk meningkatkan kualitas panen?

Catatatan: Beritanda skala priorias, 1 sebagai posisi yang paling penting

☐	A.	Bantuan Teknik
☐	B.	Bantuan Keuangan
☐	C.	Membantu proses pasca panen / bantuan pemasaran
☐	D.	Mengenalkan contoh ideal
☐	V.	Lainnya, Mohon jelaskan.....

62 Dari daftar lembaga berikut ini bagaimana derajat kegunaan dalam mendukung peningkatan produktifitas udang?

		Sangat Penting ⇒⇒Kurang Penting				
		1	2	3	4	5
A.	Pusat/Lembaga Penelitian Perguruan Tinggi	○	○	○	○	○
B.	Lembaga Penelitian Komersial	○	○	○	○	○
C.	Lembaga Penelitian perusahaan Exporter	○	○	○	○	○
D.	Penelitian mandiri dari masyarakat	○	○	○	○	○
V.	Lainnya, Mohon jelaskan…….	○	○	○	○	○

63 Jika anda memiliki dukungan yang memadai misalkan mendapatkan pelatihan apakah ada mau merubah teknik budidaya udang yang anda lakukan?

- ○ 1. Ya
- ○ 3. No……. if no, what is the consequences……Lihat ke 76

64 Jika Ya , apakah alasan anda untuk merubah metode budidaya anda?
Catatan: bisa dijawab lebih dari satu jawaban

- ○ A. Meningkatkan produktifitas, sampai……..%
- ○ B. Mengurangi resiko kegagalan panen
- ○ C. Mengikuti kawan kawan petambak lainnya
- ○ D. Untuk mendapatkan insentive yang ditawarkan
- ○ V. Lainnya, Mohon jelaskan ……..

65 Metode apakah yang anda terapkan untuk menjaga kualitas air yang digunakan?

- ○ A. Menanam pohon mangroves disekitar tambak
- ○ B. Mengunakan penyaring air
- ○ C. Tidak melakukan apa apa
- ○ D. Menggunakan bibit unggul
- ○ E. Lainnya, Mohon jelaskan……

66 Apakah ada bantuan dari luar masyarakat dalam penanggulangan polusi?
Catatatan: iJika Ya, bisa dijawab lebih dari satu jawaban

- ○ 1 Ya
  - ○ A Lembaga Pemerintah
  - ○ B Perusahaan (bagian dari program CSR)
  - ○ C NGO/LSM
  - ○ D Perusahaan pengesxport udang
  - ○ E Lainnya, Mohon jelaskan……
- ○ 3 No , Lihat ke 70

67 Dari bantuan yang berasal dari luar masyarakat berikut ini, bantuan yang bagaimana yang paling dibutuhkan di menanggulangan polusi dan atau peningkatan kualitas panen?
Catatatan: Beritanda skala priorias, 1 sebagai posisi yang paling penting

- [ ] A. Bantuan Teknik
- [ ] B. Bantuan Pembiayaan
- [ ] C. Memfasilitasi proses pasca panen/ bantuan pemasaran
- [ ] D. Mengenalkan model baru
- [ ] V. Lainnya, Mohon jelaskan……

68 For How long you receipt the assistances?

- ○ A. Kurang dari 1 bulan
- ○ B. 1-3 bulan
- ○ C. 4-6 Bulan
- ○ D. Satu tahun
- ○ E. Lebih dari satu tahun

69 Inisiatif apasaja yang telah anda lakukan sendiri dalam rangka mengurangi polusi dan meningkatkan kualitas panen?

- ○ A. Melakukan percobaan sendiri
- ○ B. Melakukan dengan asosiasi petani
- ○ C. Mencari masukan dan nasehat dari petani lain atau assosiasi petani udang diluar kabupaten sidoarjo
- ○ D. Mencari masukan dan nasehat dari petani lain atau assosiasi petani udang diluar kabupaten sidoarjo
- ○ E. Lainnya, Mohon jelaskan.....

d. Perubahan yang terjadi terkait dengan Lumpur Panas Porong

Bagian ini ingin menggambarkan pandangan petani udang atas kemunculan Lumpur panas di Porong

Catatan: SS= Sangat Setuju, S= Setuju, N=nentral, STS= Sangat Tidak setuju

No	Pernyataan	No	Pilihan Jawaban				
			SS	S	N	TS	STS
1	Semenjak bencana ini muncul, apakah anda menjalin komunikasi effective dengan pemerintah terkait dengan masalah yang anda hadapi?	1	○	○	○	○	○
2	Apakah anda sadar bila bencana lumpur panas di porong mempengaruhi kehidupan sosial anda?	2	○	○	○	○	○
3	Apakah hubungan anda dengan petani udang lainnya berubah semenjak munculnya lumpur panas di Porong?	3	○	○	○	○	○
4	Sebagai pemilik tambak udang, apakah pola komunikasi anda dengan komunitas sekitar berubah semenjak munculnya lumpur panas di Porong?	4	○	○	○	○	○
5	Apakah komunikasi dengan assosiasi petani udang effective?	5	○	○	○	○	○
6	Dalam rangka mengantisipasi terhadap dampak lumpur panas di Porong apakah anda menerapkan teknik baru dalam budidaya udang?	6	○	○	○	○	○
7	Apakah Tambak udang anda membutuhkan bantuan bantuan dari pemerintah?	7	○	○	○	○	○
8	Apakah bank atau lembaga keuangan juga dibutuhkan dalam rangka membantu penyelesaian masalah yang dihadapi petani Udang?	8	○	○	○	○	○
9	Apakah dukungan masyarakat sekitar dibutuhkan untuk menyelesaiakan masalah yang dihadapi petani udang?	9	○	○	○	○	○
10	Apakah dukungan perusahaan pengexport udang dibutuhkan menyelesaiakan masalah yang dihadapi petani udang?	10	○	○	○	○	○

11	Apakah anda merasa lebih beruntung dibanding dengan petani udang lainnya?	11	○	○	○	○	○
12	Apakah anda perlu merubah usaha inti anda?	12	○	○	○	○	○
13	Menurut anda , Apakah pemerintah harus memberi bantuan kepada anda?	13	○	○	○	○	○
14	Menurut anda , Apakah PT Lapindo harus memberi bantuan kepada anda?		○	○	○	○	○

Are you 18 years of age or more and do you currently working for one of shrimp production sector located in any of the following subdistricts: Gebang (Sidoarjo Subdistrict), Kedung Peluk (Candi Subdistrict), BanjarPanji, Banjar Asri, Penatar Sewu (Tanggulangin Subdistrict) Plumbon (Porong Subdistrict), Permisan, Tambak Kalisogo, Kupang, Kedung Pandan (Jabon Subdistrict), Sekardangan (Sidoarjo Subdistrict), Sawohan (Buduran Subdistrict), Kalanganyar, Tambak Cemandi, Banjar Kemuning (Sedati Subdistrict) and Tambak Sawah (Waru Subdistrict) ?

If so, we would like you to participate in this survey.

This survey is seeking information from shrimp farmer, government and other stakeholder responses to the Porong mud flow across nominated subdistricts with a focus on the extent of contamination and disruption of shrimp fisheries by the mudflow; the socio-economic impacts of such disruptions on shrimp fisheries production ; the diverse ways in which shrimp farmers have responded to the changing conditions; the role of government in supporting the shrimp farmer initiatives to mitigate the effects of the pollution; the extent to which existing institutional/structural arrangements in the industry have constrained or facilitated recovery; the transferability of the actions taken by shrimp farmers to other shrimp farming areas in Indonesia.

This survey will take 60 minutes to complete. You are not asked to provide your name or any personally identifying information and may exit the survey at any time

This survey has been prepared by Achmad Room Fitrianto as a part of degree in obtaining PhD at The School of Social Science and Asian Languages Curtin University, Perth. His PhD thesis title is "The socio-economic impacts of the Porong mud flow on the shrimp fisheries sector in Sidoarjo District, East Java Province Indonesia". This research is under supervision of Prof. Dr. Bob Pokrant and Dr. Aileen Hoath from the Curtin University.

This research will investigate any impacts of human or natural induced hazards that are influencing socio-economic condition of the shrimp sector. By portraying various community vulnerabilities, the research will help identify key sources of vulnerability and the particular local groups most affected by them, in this way local people will be in a better position to respond to immediate concerns and also plan for any future eventualities.

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The survey conforms to the ethics standard of Curtin University. All data collects in accordance with University guidelines to protect anonymity of individual participants. Any publications incorporating aggregated survey result and analysis will be publically available

YOUR COMPLETION OF THE SURVEY WILL BE UNDERSTOOD AS CONSENT FOR ANY DATA PROVIDED TOBE USED AS DESCRIBED ABOVE

Further assistance or information about the research and its outcomes the research can be obtained from Achmad Room Fitrianto

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No. Questionnaire :		**Date :**			
Villages No :		**Sub District No :**			

PLEASE TICK ONE BOX

a. **Basic demographic data**

The following section will provide a broad profile of the survey participants.

1 What is your gender?

○ a. Male ○ b. Female

2 What is your age?

○ a.18-25 ○ c. 46-65

○ b.26-45 ○ d. 66+

3 Education background/ Highest level education completed

○ a. Primary School ○ b. Senior High School

○ c. Junior High School ○ d. University Graduate

○ e. Others, Please Specify……

……

4 How long have you been working in shrimp industry?

○ a. Less than a year ○ c. 5-10

○ b. 1 -5 years ○ d. >10 years

5 How long have you been in your current management position?

○ a. Less than a year ○ c. 5-10

○ b. 1 -5 years ○ d. >10 years

Household data

6 How many people permanently reside in your house?

○ a.2-4 people ○ c.7-9 People

○ b.5-6 people ○ d. More than 10 people

Please provide the following data of each household member

No.	Name (initial)	Relationship to respondent	Gender		Age	Highest level of Education completed	Current Occupation
1.			M	F			
2.			M	F			
3.			M	F			
4.			M	F			
5.			M	F			
6.			M	F			
7.			M	F			

7. Does any of your children or your household member are working in the same company or same sector with you?

   ○ a. Yes, same company and same sector
   ○ b. Yes, but different company
   ○ c. No

8. What is your total value salary from working in this shrimp enterprises, including any bonuses and interest

   ○ a. Rp 100,000-Rp 500,0000
   ○ b. Rp 500,001-Rp 1000,000
   ○ c. Rp 1,000,001-Rp 1,500,000
   ○ d. Rp 1,500,001-Rp 2,000,000
   ○ e. Rp2,000,001-Rp 2,500,000
   ○ f. More than Rp 2,500,000

9 How do you have been paid?
Noted: could have more than one answer

   ○ A. Weekly
   ○ B. Monthly
   ○ C. Commissions, how many precent?
   ○ D. Profit sharing
   ○ **V. Others, please specify …….**

10 How much is your approximate household spending per month?

   ○ a. Rp 100,000-Rp 500,0000
   ○ b. Rp 500,001-Rp 1000,000
   ○ c. Rp 1,000,001-Rp 1,500,000
   ○ d. Rp 1,500,001-Rp 2,000,000
   ○ e. Rp2,000,001-Rp 2,500,000
   ○ f. More than Rp 2,500,000

b. The Business Profile

The following questions are concerned to portraying the aquaculture business organisation and its economic scale. In this section would questioned two issues, firstly the ponds/embankment premises condition, secondly the structure of the business, including the value of the business and the workers

11. Which of the following best describes the shrimp enterprise where you have employed? Please mark all that apply What kind of ponds/embankment commodity that cultivated?

Noted: could have more than one answer

Type	The method	The products	Media
○ a. Ponds	○ a. Traditional ○ b. Semi intensive ○ c. Intensive ○ d. Organic ○ e. Other, Please specify…….. …… ……	○ 1.Shrimps ○ 2. Milkfish ○ 3. Shrimp and Milkfish ○ 4. Shrimp, Milkfish, and others ○ 5. Processing ○ 99. Others please specify…… ……	○ a. Brackish water ○ b. Brackish water (combined with nearest river) ○ c. Freshwater ○ d. Fresh water (originated from nearest river) ○ e. Saltwater ○ f. Others, Please specify…… ……

Type	The method	The products	Media
○ b. Embankments	○ a. Traditional ○ b. Semi intensive ○ c. Intensive ○ d. Organic ○ e. Other, Please specify…….. …… ……	○ 1.Shrimps ○ 2. Milkfish ○ 3. Shrimp and Milkfish ○ 4. Shrimp, Milkfish, and others ○ 5. Processing ○ 99. Others please specify…… ……	○ a. Brackish water ○ b. Brackish water (combined with nearest river) ○ c. Freshwater ○ d. Fresh water (originated from nearest river) ○ e. Saltwater ○ f. Others, Please specify…… ……

12 Do you Know, what date were the ponds /embankments first established?

- ○ Day/Month /Year: ……/……/…….
- ○ Not Sure

13 On this property, has the production method always been in fish or shrimp embankment?

- ○ 1. Yes
- ○ 3. No…….go to 14

14 If it was not fish or Shrimp embankment, what it was?
Noted: could have more than one answer

- ○ A. Padi's Filed
- ○ B. Mangrove
- ○ C. Swamp
- ○ D. Savana
- ○ V. Others, please specify……

15 Does the business where you employ have a legal form? If yes, what is the legal form and ownership status of the aquaculture business premises where you employ?

○ 1 Yes

Type of Company	Date established	Status of the premises
○ 1 Limited Company (Perseroan Terbatas/PT)	(……../……../……..)	○ 1 Owned individually
○ 2 Commendatory (CV)	(……../……../……..)	○ 2 Leased
○ 3 Trade Company	(……../……../……..)	○ 3 Use for free
○ 99 Others, Please specify…… …… ……	(……../……../……..)	○ 99 Others, Please specify…… …… …… ……

○ 3 No have Legal form

16 What are the total land areas that use for business where you employ?

- ○ a. Land: ……M2
- ○ b. Building……M2

17 What is the total estimated value of the shrimp enterprises premises where you employ?
Rp:……

18 Has your business been registered (registered for TDP- Tanda Daftar Perusahaan)

- ○ 1.Yes it has, since ……/……/……
- ○ 3.No…….go to 28

19 Do you have personal Tax file numbers (TFN)?

- ○ 1.Yes , when it was issued ……/……/……
- ○ 3.No…….go to 36

20 Are you responsible for any of the following administrative tasks in the enterprise where you employ?

○	1. Earning Note or Spending note	○	1	Yes	○	3 No
○	2. Daily Journal (Daily earnings and Daily Expenditures)	○	1	Yes	○	3 No
○	3. Lost Profit Statement	○	1	Yes	○	3 No
○	4. Balance Sheet income statement	○	1	Yes	○	3 No
○	95. Others_____	○	1	Yes	○	3 No

21 Can you estimate how much initial capital was issued for starting the business?
Noted: initial start-up cost for the business exclude land building

○ 1 Yes

- ○ a. Less than Rp 2,500,0000
- ○ b. Rp 2500,001-Rp 5000,000
- ○ c. Rp 5,000,001-Rp 7,500,000
- ○ d. Rp 7,500,001-Rp 10,000,000
- ○ e. Rp10,000,001-Rp 12,500,000
- ○ f. More than Rp 12,500,000

○ 3 No go to 23

22 Has capital obtained in the business, where you employ, will used for any of the following purposes?
Note: Mark in order of importance with 1 being the most important

- ☐ A. To rent another pond
- ☐ B. To buy Shrimps feeds
- ☐ C. To pay the worker Salaries
- ☐ D. To buy Machine, Please specify……
- ☐ E. For hire consultant
- ☐ F. To develop new business, Please specify……..
- ☐ V. Others, please specify ……..

23 Which of the following source of operating capital for the business where you employ?
Noted: please mark all relevant answers

- ○ A. Bank,……(the name of bank)
- ○ B. Microfinance,……(the name of institution)
- ○ C. Cash and Converter (pegadaian)
- ○ D. Informal Moneylenders (rentenir)
- ○ E. Government Schema
- ○ F. Buying Using credit Schema from……
- ○ G Colleagues or extended family
- ○ V. Others, please specify ……..

24 Do you know what are the operational costs for running the business where you employ?

Noted: The operational cost including the worker's salary, transportation cost, row material cost and others

- ○ 1 Yes I know, Rp……
- ○ 3 No, I don't Involved

25 How frequently do you harvest your shrimp pond?

- ○ A. One's a year
- ○ B. Twice a Year
- ○ C. Three times a year
- ○ D. Four Times a Year
- ○ V. More Than five times a year, Please Specify……..

26 Can you provide an estimate of the gross annual income of the enterprises where you employ?
Noted: If not sure just the estimation

- ○ 1 Yes
  - ○ a. Less than Rp 25,000,0000
  - ○ b. Rp 25,000,001-Rp 50,000,000
  - ○ c. Rp 50,000,001-Rp 75,000,000
  - ○ d. Rp 75,000,001-Rp 100,000,000
  - ○ e. Rp100,000,001-Rp 125,000,000
  - ○ f. More than Rp 125,000,000
- ○ 3 No

27 Has the gross annual income of the business change at any time in the past 6 years?

- ○ 1. Yes
- ○ 3. No…….go to ……31

28 If Yes, have any of the following influenced that change?
Noted: could have more than one answer

- ○ A. The occurrence the Mud Volcano
- ○ B. National macro-economic conditions
- ○ C. The price of raw material increasing
- ○ D. A fall in the price of shrimp
- ○ E. The government regulation, Please specify……
- ○ V. Others, please specify ……..

29 Has the change in income been significant?

- ○ A. Some change but not significant
- ○ B. Plunge significantly, How many ……%
- ○ C. Just in dry Season, How many ……%
- ○ D. Just in Rain Season, How many ……%
- ○ V. Others, please specify ……..

30 Have the operational costs changed in last six years?

- ○ 1 Yes
- ○ 3 Don't know go to……

31 Which of the following item were affected (preference)
Note: Mark in order of importance with 1 being the most important

- ☐ A. Wages and Salary
- ☐ B. Raw material
- ☐ C. Moorgate payment
- ☐ D. Equipment
- ☐ E. Maintenance
- ☐ V. Others, please specify ……..

The worker's profile

This following questions aim to establish a profile of workers employed in the shrimp industry

32 How many workers are employed to operate the shrimp ponds and embankments?

……

33 Please indicate the number of workers who are usually employ at the shrimp ponds and embankments where you employ who usually reside at each of the following locations?

Please indicate how many for all categories that apply:

- ○ A. Communities closes to the pond location, ……..People.
- ○ B. Elsewhere in the same sub district (Kecamatan),……..People
- ○ C. Outside the sub district in which the ponds are located but still in the same district (kabupaten), ……..People
- ○ D. Outside the district (kabupaten) in which the ponds are located,……..People
- ○ V. Others, please specify ……..

34 Do you have family relationship with the owner/manager of this pond?

- ○ 1. Yes
- ○ 3. No

35 Any of your family members employed in this business?

- ○ 1. Yes, ……people
- ○ 3. No……got to

36 What is their relationship to you?

Note: mark all that are relevant

- ○ A. Children
- ○ B. Spouse
- ○ C. Spouse relative
- ○ D. Your relative
- ○ V. Others, please specify ……..

37 What is you reason you working in this sector?

Noted: could have more than one answer

- ○ A. We need a job
- ○ B. we are trust worthy
- ○ C. We are cheap
- ○ D. We have suitable skills
- ○ E. Have no other choices
- ○ V. Others, please specify ……..

The following questions concern the scope of marketing chains utilized by the shrimp enterprises where you employ. The aims to understand the significance of the aquaculture toward other sectors

38 Are you involved in marketing the products for the enterprises?

○ 1 Yes ○ 3 No, I don't involve, go to no 46

39 Which part of selling/marketing is your responsibility?

- ○ A Selling locally
- ○ B Helping in export preparation
- ○ V Others_____

40 Which markets does the shrimp enterprise where you employ usually services?
Note: Mark in order of importance with 1 being the most important

- ☐ 1. Local Villages
- ☐ 2. Innercity (Sidoarjo)
- ☐ 3. Other cities in East Java Province
- ☐ 4. Indonesian markets out side East Java Province
- ☐ 5. Overseas
- ☐ 95. Others_____

41 What are the payment methods that apply in your business?
Note: Mark in order of importance with 1 being the most important

- ☐ A. Direct Payment
- ☐ B. Credit
- ☐ V. Others,……..

42 The Payment Instrument

Note: Mark in order of importance with 1 being the most important

☐	A.	Cash
☐	B.	Debit Card
☐	C.	Credit Card
☐	D.	Cheque
☐	E.	Bank Transfer
☐	V.	Others, please specify ……..

43 Please indicate what percentage of your total production is marketed in the traditional market

Note: Mark one circle only

- ○ A. 1-5%
- ○ B. 6-15%
- ○ C. 16-20%
- ○ D. 21-25%
- ○ E. More than 25%

44 Please indicate what percentage of total production from the enterprise where you employis marketed in the export market.

Note: Mark one circle only

- ○ A. 1-10%
- ○ B. 11-20%
- ○ C. 21-30%
- ○ D. 31-40%
- ○ E. 41-50%
- ○ F. More than 50%

45 Which of the following products does the enterprise you manage send to the buyer?

Note: Mark in order of importance, with 1. being of greatest importance

☐	A.	Life Shrimps
☐	B.	HOSO (Head On Shell On)
☐	C.	HLSO (Head Less Shell On)
☐	D.	PD (Peel Devine)
☐	V.	Others, Please Specify……..

46 How do you send your harvested shrimp to the market?

- ○ A. Picked up directly by the buyer
- ○ B. You send to the depot with your own vehicle
- ○ C. You use a courier to deliver
- ○ D. All dispersal of the harvest is coordinated by a farmer association
- ○ V. Others, Please Specify……..

47 How important are each of this markets to your enterprises

			Very Important ⇒⇒Less Important				
			1	2	3	4	5
☐	A.	Export	○	○	○	○	○
	B.	Restaurants	○	○	○	○	○
	C.	Shrimp Crackers (Krupuk Udang)	○	○	○	○	○
	D.	Shrimp Paste (Petis udang)	○	○	○	○	○
☐	E.	Shrimp Nibles (makanan kecil)	○	○	○	○	○
	F.	Export manufacturing shrimp products	○	○	○	○	○
	G	Traditional warket	○	○	○	○	○
☐	V.	Others, Please Specify……..	○	○	○	○	○

c. Significant changes in the operation over time

This section aims to obtain information about the shrimp production process before and after the commencement of the Porong Mud Volcano.

48 Where does the enterprise where you employ, obtain the following raw fish stock and supplies ?

Shrimp fries		Shrimp feed		Ponds/ Embankment equipment	
○ A.	Capture directly from The sea	○ A.	Scheduled by the association	○ A.	Assembling it self
○ B.	From agent recommended by the Agricultural Assistance Official (Petugas Penyuluh Pertanian)	○ B.	Scheduled by the Agricultural Assistance official (Petugas Penyuluh Pertanian)	○ B.	Assisted by the Agricultural Assistance Official (Petugas Penyuluh Pertanian)
○ C.	Supplied by the depot	○ C.	Direct order from the store based on your need	○ C.	Supplied by the depot
○ D.	Supplied by the buyers	○ D.	Ordered from Association according to the need (on demand)	○ D.	Supplied from buyer
○ E.	Purchased from hatchery	○ E.	Supplied by the buyers	○ E.	Purchase from the store
○ V.	Others, Please specify…… ……	○ V.	Others, please specify …… ……..	○ V.	Others, Please Specify…… ……

49 Delivery model that apply in sending the shrimp fries?

Shrimp fries	Shrimp feed	Ponds/ Embankment equipment
○ A. Sent by Seller	○ A. Sent by Seller	○ A. Sent by seller
○ B. Pick up on store	○ B. Pick up on store	○ B. Pick up on store
○ C. Using courrier agency	○ C. Using courrier agency	○ C. Using courrier agency
○ D. Coordinated by the association	○ D. Coordinated by the association	○ D. Coordinated by the association
○ V. Others, Please Specify…… .	○ V. Others, Please Specify……..	○ V. Others, Please Specify……

50 In the past 6 years, has there been any change in obtaining raw materials?

○ A. Yes, Please comment what the difference……
……

○ B. No……go to

51 Which of the following factors have contribute to the change?
Note: could have more than one answer

○ A. The occurring of mud volcano
○ B. The national macro economy conditions
○ C. The national price of the shrimp feed
○ D. The price of Shrimp fall down
○ E. The government regulation, Please specify……
○ V. Others, please specify ……..

52 When did the change occur?

○ A. Before 29 May 2006
○ B. After 29 May 2006
○ V. Others, Please specify……..

53 Is has there been change in production level

○ A. Sudden drop
○ B. sudden death
○ c sudden stock loss
○ V. Others, Please specify……..

54 In the past 6 years, has the shrimp enterprise where you employ change its cultivation method in any way that you are aware of?

○ 1. Yes
○ 3. No…….go to 76

55 Which any of the following significantly determine the production level

			Very Important ⇒⇒Less Important				
			1	2	3	4	5
	A.	The Occurring of Mud Volcano	○	○	○	○	○
	B.	The National Macro economy conditions	○	○	○	○	○
	C.	The National price of the shrimp feed	○	○	○	○	○
	D.	The price of Shrimp fall down	○	○	○	○	○
	E.	The government regulation, Please specify…….	○	○	○	○	○
	V.	Others, please specify ……..	○	○	○	○	○

56 Do you practicing any special technique in cultivate shrimp especially in facing the water degradation quality caused by the occurring Mud Volcano in Porong?

○ 1 Yes please specify.....

○ 3 No

57 Do any local wisdoms or traditions inspire your cultivation techniques

○ 1 Yes please specify.....
.....

○ 3 No

58 Does your employer encourage and support developing new shrimp cultivation technique

○ 1 Yes, what kind of support provided?……
……

○ 3 No

59 Is there currently any government support to increase the harvest quality?

○ 1 Yes

○ 3 No

60 Which of the following government support that most needed in increasing the harvest quality?
Note: Mark in order of importance with 1 being the most important

	A.	Technical assistances
	B.	Financial assistances
	C.	Facilitate the post harvested process/ marketing assistances
	D.	Introducing role model
	V.	Others, please specify.....

61 Would any of the following be helpful

		Very Important ⇒⇒Less Important				
		1	2	3	4	5
A.	University research centre	○	○	○	○	○
B.	Commercial research centre	○	○	○	○	○
C.	Exporter company research centre	○	○	○	○	○
D.	Community develop indepent research	○	○	○	○	○
V.	Other, please specify…….	○	○	○	○	○

62 If you had adequate support, would you wish to change you CULTIVATION method that you applying?

- ○ 1. Yes
- ○ 3. No……. if no, what is the consequences……go to 76

63 If Yes, Would you tell the reason why do you changing?
Noted: could have more than one answer

- ○ A. Increase the productivity, up to……..%
- ○ B. Reducing the Risk of Harvest failure
- ○ C. Following the peers colleagues
- ○ D. In obtain the incentives offered
- ○ V. Others, please specify ……..

64 What kind of method do you use for water stock control?

- ○ A. Planting mangroves surrounding the ponds
- ○ B. Make water filter
- ○ C. Do nothing
- ○ D. Using pollutant- resistance seedlings
- ○ E. Others, please specify……

65 Does any assistance from outside parties in pollution prevention efforts
Note: if yes, could have more than one answers

○ 1 Yes

○	A	Goverment Agencies
○	B	Company (CSR)
○	C	NGO
○	D	Shrimp exporter company
○	E	others, Please specify……

○ 3 No , go to

66 Which of the following outside parties support that most needed in pollution prevention efforts and increasing the harvest quality?
Note: Mark in order of importance with 1 being the most important

- [ ] A. Technical assistances
- [ ] B. Financial assistances
- [ ] C. Facilitate the post harvested process/ marketing assistances
- [ ] D. Introducing role model
- [ ] V. Others, please specify……

67 For How long you receipt the assistances?

- ○ A. Less than 1 month
- ○ B. 1-3 months
- ○ C. 4-6 months
- ○ D. one year
- ○ E. More than one years

68 What kinds of initiatives have you establish yourself?

- ○ A. Conduct my own experiment
- ○ B. Conduct experiment with the farmer association
- ○ C. Seeking advice from other farmers or other farmer association who are located outside Sidoarjo
- ○ D. Seeking advice from other farmers or other farmer association who are located outside East Java
- ○ E. Other, please specify.....

d. The changes were related to the Porong mud volcano

This section is aimed to portrayed the shrimp farmer perspective toward the Porong mud volcano

No	Statement	No	Answer options				
			SA	A	NAD	D	SD
1	Do you consider that the Porong mud volcano has socially effect on your social life?	1	○	○	○	○	○
2	Has your relationship among the other shrimp farmers changed since the occurring of the Porong mud volcano?	2	○	○	○	○	○
3	As shrimp enterprise worker has your need for communication with the local community change since the occurring of the Porong mud volcano?	3	○	○	○	○	○
4	Is the communication with the farmer association effective?	4	○	○	○	○	○
5	In order to adapt to the impact of the Porong mud volcano, have you need to apply new technique in shrimp farming?	5	○	○	○	○	○
6	Has the enterprise where you employ required government assistances?	6	○	○	○	○	○
7	Do banks/ financial institution are needed in solving the shrimp farmer problems	7	○	○	○	○	○
8	Does community support are needed in solving the shrimp farmer problems	8	○	○	○	○	○
9	Does shrimp exporter company supports are needed in solving the shrimp farmer problems?	9	○	○	○	○	○
10	Do you feel that you have fared better than other victims?	10	○	○	○	○	○
11	Have you had a need to change your business core?	11	○	○	○	○	○
12	Do you think the government (central/local) should provide assistance to you?	12	○	○	○	○	○
13	Do you think PT Lapindo should provide assistance to you?	13	○	○	○	○	○

Are you 18 years of age or more and do you currently manage a shrimp production sector located in any of the following subdistricts: Gebang (Sidoarjo Subdistrict), Kedung Peluk (Candi Subdistrict), BanjarPanji, Banjar Asri, Penatar Sewu (Tanggulangin Subdistrict) Plumbon (Porong Subdistrict), Permisan, Tambak Kalisogo, Kupang, Kedung Pandan (Jabon Subdistrict), Sekardangan (Sidoarjo Subdistrict), Sawohan (Buduran Subdistrict), Kalanganyar, Tambak Cemandi, Banjar Kemuning (Sedati Subdistrict) and Tambak Sawah (Waru Subdistrict) ?

If so, we would like you to participate in this survey.

This survey is seeking information from shrimp farmer, government and other stakeholder responses to the Porong mud flow across nominated subdistricts with a focus on the extent of contamination and disruption of shrimp fisheries by the mudflow; the socio-economic impacts of such disruptions on shrimp fisheries production ; the diverse ways in which shrimp farmers have responded to the changing conditions; the role of government in supporting the shrimp farmer initiatives to mitigate the effects of the pollution; the extent to which existing institutional/structural arrangements in the industry have constrained or facilitated recovery; the transferability of the actions taken by shrimp farmers to other shrimp farming areas in Indonesia.

This survey will take 60 minutes to complete. You are not asked to provide your name or any personally identifying information and may exit the survey at any time

This survey has been prepared by Achmad Room Fitrianto as a part of degree in obtaining PhD at The School of Social Science and Asian Languages Curtin University, Perth. His PhD thesis title is "The socio-economic impacts of the Porong mud flow on the shrimp fisheries sector in Sidoarjo District, East Java Province Indonesia". This research is under supervision of Prof. Dr. Bob Pokrant and Dr. Aileen Hoath from the Curtin University.

This research will investigate any impacts of human or natural induced hazards that are influencing socio-economic condition of the shrimp sector. By portraying various community vulnerabilities, the research will help identify key sources of vulnerability and the particular local groups most affected by them, in this way local people will be in a better position to respond to immediate concerns and also plan for any future eventualities.

This research degree is funded by The Ministry of Education and Culture Republic of Indonesia under the Directorate General of Higher Education Scholarship (DIKTI) Bench 5

The survey conforms to the ethics standard of Curtin University. All data collects in accordance with University guidelines to protect anonymity of individual participants. Any publications incorporating aggregated survey result and analysis will be publically available

YOUR COMPLETION OF THE SURVEY WILL BE UNDERSTOOD AS CONSENT FOR ANY DATA PROVIDED TOBE USED AS DESCRIBED ABOVE

Further assistance or information about the research and its outcomes the research can be obtained from Achmad Room Fitrianto

Achmad Room Fitrianto

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Curtin University

No. Questionnaire :		**Date :**			
Villages No :		**Sub District No :**			

PLEASE TICK ONE BOX

a. **Basic demographic data**

The following section will provide a broad profile of the survey participants.

1 What is your gender?

○ a. Male ○ b. Female

2 What is your age?

○ a.18-25 ○ c. 46-65

○ b.26-45 ○ d. 66+

3 Education background/ Highest level education completed

○ a. Primary School ○ b. Senior High School

○ c. Junior High School ○ d. University Graduate

○ e. Others, Please Specify……

……

4 How long have you been working in shrimp industry?

○ a. Less than a year ○ c. 5-10

○ b. 1 -5 years ○ d. >10 years

5 How long have you been in your current management position?

○ a. Less than a year ○ c. 5-10

○ b. 1 -5 years ○ d. >10 years

Household data

6 How many people permanently reside in your house?

○ a.2-4 people ○ c.7-9 People

○ b.5-6 people ○ d. More than 10 people

Please provide the following data of each household member

No.	Name (initial)	Relationship to respondent	Gender		Age	Highest level of Education completed	Current Occupation
1.			M	F			
2.			M	F			
3.			M	F			
4.			M	F			
5.			M	F			
6.			M	F			
7.			M	F			

7. Does any of your children or your household member are working in the same company or same sector with you?

   ○ a. Yes, same company and same sector
   ○ b. Yes, but different company
   ○ c. No

8. What is your total value salary from managing the shrimp enterprises, including any bonuses and interest

   ○ a. Rp 100,000-Rp 500,0000
   ○ b. Rp 500,001-Rp 1000,000
   ○ c. Rp 1,000,001-Rp 1,500,000
   ○ d. Rp 1,500,001-Rp 2,000,000
   ○ e. Rp2,000,001-Rp 2,500,000
   ○ f. More than Rp 2,500,000

9 How do you have been paid?
Noted: could have more than one answer

   ○ A. Weekly
   ○ B. Monthly
   ○ C. Commissions, how many precent?
   ○ D. Profit sharing
   ○ **V. Others, please specify …….**

10 How much is your approximate household spending per month?

   ○ a. Rp 100,000-Rp 500,0000
   ○ b. Rp 500,001-Rp 1000,000
   ○ c. Rp 1,000,001-Rp 1,500,000
   ○ d. Rp 1,500,001-Rp 2,000,000
   ○ e. Rp2,000,001-Rp 2,500,000
   ○ f. More than Rp 2,500,000

b. The Business Profile

The following questions are concerned to portraying the aquaculture business organisation and its economic scale. In this section would questioned two issues, firstly the ponds/embankment premises condition, secondly the structure of the business, including the value of the business and the workers

11. Which of the following best describes the shrimp enterprise that you manage? Please mark all that apply What kind of ponds/embankment commodity that cultivated by you?

Noted: could have more than one answer

Type	The method	The products	Media
○ a. Ponds	○ a. Traditional ○ b. Semi intensive ○ c. Intensive ○ d. Organic ○ e. Other, Please specify…….. …… ……	○ 1.Shrimps ○ 2. Milkfish ○ 3. Shrimp and Milkfish ○ 4. Shrimp, Milkfish, and others ○ 5. Processing ○ 99. Others please specify…… ……	○ a. Brackish water ○ b. Brackish water (combined with nearest river) ○ c. Freshwater ○ d. Fresh water (originated from nearest river) ○ e. Saltwater ○ f. Others, Please specify…… ……

Type	The method	The products	Media
○ b. Embankments	○ a. Traditional ○ b. Semi intensive ○ c. Intensive ○ d. Organic ○ e. Other, Please specify…….. …… ……	○ 1.Shrimps ○ 2. Milkfish ○ 3. Shrimp and Milkfish ○ 4. Shrimp, Milkfish, and others ○ 5. Processing ○ 99. Others please specify…… ……	○ a. Brackish water ○ b. Brackish water (combined with nearest river) ○ c. Freshwater ○ d. Fresh water (originated from nearest river) ○ e. Saltwater ○ f. Others, Please specify…… ……

12 What date were the ponds /embankments first established?

- ○ Day/Month /Year: ……/……/…….
- ○ Not Sure

13 On this property, has the production method always been in fish or shrimp embankment?

- ○ 1. Yes
- ○ 3. No…….go to 13

14 If it was not fish or Shrimp embankment, what it was?
Noted: could have more than one answer

- ○ A. Padi's Filed
- ○ B. Mangrove
- ○ C. Swamp
- ○ D. Savana
- ○ V. Others, please specify……

15 Does the business that you manage have a legal form? If yes, what is the legal form and ownership status of the aquaculture business premises that you manage?

○ 1 Yes

Type of Company	Date established	Status of the premises
○ 1 Limited Company (Perseroan Terbatas/PT)	(……../……../……..)	○ 1 Owned individually
○ 2 Commendatory (CV)	(……../……../……..)	○ 2 Leased
○ 3 Trade Company	(……../……../……..)	○ 3 Use for free
○ 99 Others, Please specify…… …… ……	(……../……../……..)	○ 99 Others, Please specify…… …… …… ……

○ 3 No have Legal form

16 What are the total land areas that use for business that you manage?

- ○ a. Land: ……M2
- ○ b. Building……M2

17 What is the total estimated value of the shrimp enterprises premises that you manage?
Rp:……

18 Has your business been registered (registered for TDP- Tanda Daftar Perusahaan)

- ○ 1. Yes it has, since ……/……/…….
- ○ 3.No…….go to 28

19 Do you have personal Tax file numbers (TFN)?

- ○ 1. Yes, when it was issued ……/……/…….
- ○ 3.No…….go to 36

20 Are you responsible for any of the following administrative tasks in the enterprise that you manage?

○	1.	Earning Note or Spending note	○ 1	Yes	○ 3	No
○	2.	Daily Journal (Daily earnings and Daily Expenditures)	○ 1	Yes	○ 3	No
○	3.	Lost Profit Statement	○ 1	Yes	○ 3	No
○	4.	Balance Sheet income statement	○ 1	Yes	○ 3	No
○	95.	Others_____	○ 1	Yes	○ 3	No

21 Can you estimate how much initial capital was issued for starting the business?
Noted: initial start-up cost for the business exclude land building

○ 1 Yes

- ○ a. Less than Rp 2,500,0000
- ○ b. Rp 2500,001-Rp 5000,000
- ○ c. Rp 5,000,001-Rp 7,500,000
- ○ d. Rp 7,500,001-Rp 10,000,000
- ○ e. Rp10,000,001-Rp 12,500,000
- ○ f. More than Rp 12,500,000

○ 3 No

22 Has capital obtained in the business that you manage will used for any of the following purposes?
Note: Mark in order of importance with 1 being the most important

- ☐ A. To rent another pond
- ☐ B. To buy Shrimps feeds
- ☐ C. To pay the worker Salaries
- ☐ D. To buy Machine, Please specify……
- ☐ E. For hire consultant
- ☐ F. To develop new business, Please specify……..
- ☐ V. Others, please specify ……..

23 Which of the following source of operating capital for the business that you manage?
Noted: please mark all relevant answers

- ○ A. Bank,……(the name of bank)
- ○ B. Microfinance,……(the name of institution)
- ○ C. Cash and Converter (pegadaian)
- ○ D. Informal Moneylenders (rentenir)
- ○ E. Government Schema
- ○ F. Buying Using credit Schema from…….
- ○ G Colleagues or extended family
- ○ V. Others, please specify ……..

24 Do you know, what are the operational costs for running the business that you manage?

Noted: The operational cost including the worker's salary, transportation cost, row material cost and others

- ○ 1 Yes I know, Rp……
- ○ 3 No, I don't Involved

25 How frequently do you harvest your shrimp pond?

- ○ A. One's a year
- ○ B. Twice a Year
- ○ C. Three times a year
- ○ D. Four Times a Year
- ○ V. More Than five times a year, Please Specify……..

26 Can you provide an estimate of the gross annual income of the enterprises that you manage?
Noted: If not sure just the estimation

- ○ 1 Yes
  - ○ a. Less than Rp 25,000,0000
  - ○ b. Rp 25,000,001-Rp 50,000,000
  - ○ c. Rp 50,000,001-Rp 75,000,000
  - ○ d. Rp 75,000,001-Rp 100,000,000
  - ○ e. Rp100,000,001-Rp 125,000,000
  - ○ f. More than Rp 125,000,000
- ○ 3 No

27 Has the gross annual income of the business change at any time in the past 6 years?

- ○ 1. Yes
- ○ 3. No…….go to …….

28 If Yes, have any of the following influenced that change?
Noted: could have more than one answer

- ○ A. The occurrence the Mud Volcano
- ○ B. National macro-economic conditions
- ○ C. The price of raw material increasing
- ○ D. A fall in the price of shrimp
- ○ E. The government regulation, Please specify……
- ○ V. Others, please specify ……..

29 Has the change in income been significant?

- ○ A. Some change but not significant
- ○ B. Plunge significantly, How many ……%
- ○ C. Just in dry Season, How many ……%
- ○ D. Just in Rain Season, How many ……%
- ○ V. Others, please specify ……..

30 Have the operational costs changed in last six years?

- ○ 1 Yes
- ○ 3 Don't know go to……

31 Which of the following item were affected (preference)
Note: Mark in order of importance with 1 being the most important

- ☐ A. Wages and Salary
- ☐ B. Raw material
- ☐ C. Moorgate payment
- ☐ D. Equipment
- ☐ E. Maintenance
- ☐ V. Others, please specify ……..

The worker's profile

This following questions aim to establish a profile of workers employed in the shrimp industry

32 How many workers are employed to operate the shrimp ponds and embankments that you manage?

……

33 Do you responsible in managing fieldworkers? How many workers that you managed?

○ 1 Yes, I responsible for……People ○ 3 No, I don't have such responsibility

34 Please indicate the number of workers who are usually employed at the shrimp ponds and embankments that you manage who usually reside at each of the following locations?

Please indicate how many for all categories that apply:

○ A. Communities closes to the pond location, ……..People.

○ B. Elsewhere in the same sub district (Kecamatan),……..People

○ C. Outside the sub district in which the ponds are located but still in the same district (kabupaten), ……People

○ D. Outside the district (kabupaten) in which the ponds are located,……People

○ V. Others, please specify ……..

35 Any of your family members employed in this business?

○ 1. Yes, ……people

○ 3. No……got to

36 What is their relationship to you?

Note: mark all that are relevant

○ A. Children

○ B. Spouse

○ C. Spouse relative

○ D. Your relative

○ V. Others, please specify
……..

37 If Yes, which of the following apply to their situation?

Noted: could have more than one answer

- ○ A. They need a job
- ○ B. They are trust worthy
- ○ C. They are cheap
- ○ D. They have suitable skills
- ○ E. Have no other choices
- ○ V. Others, please specify ……..

The following questions concern the scope of marketing chains utilized by the shrimp enterprises that you manage. The aims to understand the significance of the aquaculture toward other sectors

38 Are you involved in marketing the products for the enterprises?

○ 1 Yes ○ 3 No, I don't involve, go to no

39 Which part of selling/marketing is your responsibility?

- ○ A Selling locally
- ○ B Helping in export preparation
- ○ V Others_____

40 Which markets does the shrimp enterprise that you manage usually services?
Note: Mark in order of importance with 1 being the most important

- ☐ 1. Local Villages
- ☐ 2. Innercity (Sidoarjo)
- ☐ 3. Other cities in East Java Province
- ☐ 4. Indonesian markets out side East Java Province
- ☐ 5. Overseas
- ☐ 95. Others_____

41 What are the payment methods that apply in your business?
Note: Mark in order of importance with 1 being the most important

- ☐ A. Direct Payment
- ☐ B. Credit
- ☐ V. Others,……..

42 The Payment Instrument

Note: Mark in order of importance with 1 being the most important

☐	A.	Cash
☐	B.	Debit Card
☐	C.	Credit Card
☐	D.	Cheque
☐	E.	Bank Transfer
☐	V.	Others, please specify ……..

43 Please indicate what percentage of your total production is marketed in the traditional market

Note: Mark one circle only

- ○ A. 1-5%
- ○ B. 6-15%
- ○ C. 16-20%
- ○ D. 21-25%
- ○ E. More than 25%

44 Please indicate what percentage of total production from the enterprise that you manage is marketed in the export market.

Note: Mark one circle only

- ○ A. 1-10%
- ○ B. 11-20%
- ○ C. 21-30%
- ○ D. 31-40%
- ○ E. 41-50%
- ○ F. More than 50%

45 Which of the following products does the enterprise you manage send to the buyer?

Note: Mark in order of importance, with 1. being of greatest importance

☐	A.	Life Shrimps
☐	B.	HOSO (Head On Shell On)
☐	C.	HLSO (Head Less Shell On)
☐	D.	PD (Peel Devine)
☐	V.	Others, Please Specify……..

46 How do you send your harvested shrimp to the market?

- ○ A. Picked up directly by the buyer
- ○ B. You send to the depot with your own vehicle
- ○ C. You use a courier to deliver
- ○ D. All dispersal of the harvest is coordinated by a farmer association
- ○ V. Others, Please Specify……..

47 How important are each of this markets to your enterprises

			Very Important ⇒⇒Less Important				
			1	2	3	4	5
☐	A.	Export	○	○	○	○	○
	B.	Restaurants	○	○	○	○	○
	C.	Shrimp Crackers (Krupuk Udang)	○	○	○	○	○
	D.	Shrimp Paste (Petis udang)	○	○	○	○	○
☐	E.	Shrimp Nibles (makanan kecil)	○	○	○	○	○
	F.	Export manufacturing shrimp products	○	○	○	○	○
	G	Traditional warket	○	○	○	○	○
☐	V.	Others, Please Specify……..	○	○	○	○	○

c. Significant changes in the operation over time

This section aims to obtain information about the shrimp production process before and after the commencement of the Porong Mud Volcano.

48 Where does the enterprise that you manage obtain the following raw fish stock and supplies?

Shrimp fries		Shrimp feed		Ponds/ Embankment equipment	
○ A.	Capture directly from The sea	○ A.	Scheduled by the association	○ A.	Assembling it self
○ B.	From agent recommended by the Agricultural Assistance Official (Petugas Penyuluh Pertanian)	○ B.	Scheduled by the Agricultural Assistance official (Petugas Penyuluh Pertanian)	○ B.	Assisted by the Agricultural Assistance Official (Petugas Penyuluh Pertanian)
○ C.	Supplied by the depot	○ C.	Direct order from the store based on your need	○ C.	Supplied by the depot
○ D.	Supplied by the buyers	○ D.	Ordered from Association according to the need (on demand)	○ D.	Supplied from buyer
○ E.	Purchased from hatchery	○ E.	Supplied by the buyers	○ E.	Purchase from the store
○ V.	Others, Please specify…… ……	○ V.	Others, please specify …… ……..	○ V.	Others, Please Specify…… ……

49 Delivery model that apply in sending the shrimp fries?

Shrimp fries	Shrimp feed	Ponds/ Embankment equipment
○ A. Sent by Seller	○ A. Sent by Seller	○ A. Sent by seller
○ B. Pick up on store	○ B. Pick up on store	○ B. Pick up on store
○ C. Using courrier agency	○ C. Using courrier agency	○ C. Using courrier agency
○ D. Coordinated by the association	○ D. Coordinated by the association	○ D. Coordinated by the association
○ V. Others, Please Specify…… .	○ V. Others, Please Specify……..	○ V. Others, Please Specify……

50 In the past 6 years, has there been any change in obtaining raw materials?

○ A. Yes, Please comment what the difference……
……

○ B. No……go to

51 Which of the following factors have contributed to the change?
Note: could have more than one answer

○ A. The occurring of mud volcano
○ B. The national macro economy conditions
○ C. The national price of the shrimp feed
○ D. The price of Shrimp fall down
○ E. The government regulation, Please specify……
○ V. Others, please specify ……..

52 When did the change occur?

○ A. Before 29 May 2006
○ B. After 29 May 2006
○ V. Others, Please specify……..

53 Is has there been change in production level (sudden drop in production / death)

○ A. Sudden drop
○ B. sudden death
○ c sudden stock loss
○ V. Others, Please specify……

54 In the past 6 years, has the shrimp enterprise that you manage changed its cultivation method in any way that you are aware of?

○ 1. Yes
○ 3. No…….go to 76

55 Which any of the following significantly determine the production level

			Very Important ⇒⇒Less Important				
			1	2	3	4	5
	A.	The Occurring of Mud Volcano	○	○	○	○	○
	B.	The National Macro economy conditions	○	○	○	○	○
	C.	The National price of the shrimp feed	○	○	○	○	○
	D.	The price of Shrimp fall down	○	○	○	○	○
	E.	The government regulation, Please specify…….	○	○	○	○	○
	V.	Others, please specify ……..	○	○	○	○	○

56 Do you practicing any special technique in cultivate shrimp especially in facing the water degradation quality caused by the occurring Mud Volcano in Porong?

○ 1 Yes please specify.....

○ 3 No

57 Do any local wisdoms or traditions inspire your cultivation techniques

○ 1 Yes please specify.....
.....

○ 3 No

58 Does your employer encourage and support developing new shrimp cultivation technique

○ 1 Yes, what kind of support provided?……
……

○ 3 No

59 Is there currently any government support to increase the harvest quality?

○ 1 Yes

○ 3 No

60 Which of the following government support that most needed in increasing the harvest quality?
Note: Mark in order of importance with 1 being the most important

	A.	Technical assistances
	B.	Financial assistances
	C.	Facilitate the post harvested process/ marketing assistances
	D.	Introducing role model
	V.	Others, please specify.....

61 Would any of the following be helpful

		Very Important ⇒⇒Less Important				
		1	2	3	4	5
A.	University research centre	○	○	○	○	○
B.	Commercial research centre	○	○	○	○	○
C.	Exporter company research centre	○	○	○	○	○
D.	Community develop indepent research	○	○	○	○	○
V.	Other, please specify……	○	○	○	○	○

62 If you had adequate support, would you wish to change you CULTIVATION method that you applying?

- ○ 1. Yes
- ○ 3. No……. if no, what is the consequences……go to 76

63 If Yes, Would you tell the reason why do you changing?
Noted: could have more than one answer

- ○ A. Increase the productivity, up to……..%
- ○ B. Reducing the Risk of Harvest failure
- ○ C. Following the peers colleagues
- ○ D. In obtain the incentives offered
- ○ V. Others, please specify ……..

64 What kind of method do you use for water stock control?

- ○ A. Planting mangroves surrounding the ponds
- ○ B. Make water filter
- ○ C. Do nothing
- ○ D. Using pollutant- resistance seedlings
- ○ E. Others, please specify……

65 Does any assistance from outside parties in pollution prevention efforts
Note: if yes, could have more than one answers

○ 1 Yes

○	A	Goverment Agencies
○	B	Company (CSR)
○	C	NGO
○	D	Shrimp exporter company
○	E	others, Please specify……

○ 3 No , go to

66 Which of the following outside parties support that most needed in pollution prevention efforts and increasing the harvest quality?
Note: Mark in order of importance with 1 being the most important

- ☐ A. Technical assistances
- ☐ B. Financial assistances
- ☐ C. Facilitate the post harvested process/ marketing assistances
- ☐ D. Introducing role model
- ☐ V. Others, please specify……

67 For How long you receipt the assistances?

- ○ A. Less than 1 month
- ○ B. 1-3 months
- ○ C. 4-6 months
- ○ D. one year
- ○ E. More than one years

68 What kinds of initiatives have you establish yourself?

- ○ A. Conduct my own experiment
- ○ B. Conduct experiment with the farmer association
- ○ C. Seeking advice from other farmers or other farmer association who are located outside Sidoarjo
- ○ D. Seeking advice from other farmers or other farmer association who are located outside East Java
- ○ E. Other, please specify.....

d. The changes were related to the Porong mud volcano

This section is aimed to portrayed the shrimp farmer perspective toward the Porong mud volcano

No	Statement	No	Answer options				
			SA	A	NAD	D	SD
1	Do you consider that the Porong mud volcano has socially effect on your social life?	1	○	○	○	○	○
2	Has your relationship among the other shrimp farmers changed since the occurring of the Porong mud volcano?	2	○	○	○	○	○
3	As the manager of a shrimp enterprise has your need for communication with the local community change since the occurring of the Porong mud volcano?	3	○	○	○	○	○
4	Is the communication with the farmer association effective?	4	○	○	○	○	○
5	In order to adapt to the impact of the Porong mud volcano, have you need to apply new technique in shrimp farming?	5	○	○	○	○	○
6	Has the enterprise that you manage required government?	6	○	○	○	○	○
7	Do banks/ financial institution are needed in solving the shrimp farmer problems	7	○	○	○	○	○
8	Does community support are needed in solving the shrimp farmer problems	8	○	○	○	○	○
9	Does shrimp exporter company supports are needed in solving the shrimp farmer problems?	9	○	○	○	○	○
10	Do you feel that you have fared better than other victims?	10	○	○	○	○	○
11	Have you had a need to change your business core?	11	○	○	○	○	○
12	Do you think the government (central/local) should provide assistance to you?	12	○	○	○	○	○
13	Do you think PT Lapindo should provide assistance to you?	13	○	○	○	○	○

Are you 18 years of age or more and do you currently owned shrimp production sector located in any of the following subdistricts: Gebang (Sidoarjo Subdistrict), Kedung Peluk (Candi Subdistrict), BanjarPanji, Banjar Asri, Penatar Sewu (Tanggulangin Subdistrict) Plumbon (Porong Subdistrict), Permisan, Tambak Kalisogo, Kupang, Kedung Pandan (Jabon Subdistrict), Sekardangan (Sidoarjo Subdistrict), Sawohan (Buduran Subdistrict), Kalanganyar, Tambak Cemandi, Banjar Kemuning (Sedati Subdistrict) and Tambak Sawah (Waru Subdistrict) ?

If so, we would like you to participate in this survey.

This survey is seeking information from shrimp farmer, government and other stakeholder responses to the Porong mud flow across nominated subdistricts with a focus on the extent of contamination and disruption of shrimp fisheries by the mudflow; the socio-economic impacts of such disruptions on shrimp fisheries production ; the diverse ways in which shrimp farmers have responded to the changing conditions; the role of government in supporting the shrimp farmer initiatives to mitigate the effects of the pollution; the extent to which existing institutional/structural arrangements in the industry have constrained or facilitated recovery; the transferability of the actions taken by shrimp farmers to other shrimp farming areas in Indonesia.

This survey will take 60 minutes to complete. You are not asked to provide your name or any personally identifying information and may exit the survey at any time

This survey has been prepared by Achmad Room Fitrianto as a part of degree in obtaining PhD at The School of Social Science and Asian Languages Curtin University, Perth. His PhD thesis title is “The socio-economic impacts of the Porong mud flow on the shrimp fisheries sector in Sidoarjo District, East Java Province Indonesia". This research is under supervision of Prof. Dr. Bob Pokrant and Dr. Aileen Hoath from the Curtin University.

This research will investigate any impacts of human or natural induced hazards that are influencing socio-economic condition of the shrimp sector. By portraying various community vulnerabilities, the research will help identify key sources of vulnerability and the particular local groups most affected by them, in this way local people will be in a better position to respond to immediate concerns and also plan for any future eventualities.

This research degree is funded by The Ministry of Education and Culture Republic of Indonesia under the Directorate General of Higher Education Scholarship (DIKTI) Bench 5

The survey conforms to the ethics standard of Curtin University. All data collects in accordance with University guidelines to protect anonymity of individual participants. Any publications incorporating aggregated survey result and analysis will be publically available

YOUR COMPLETION OF THE SURVEY WILL BE UNDERSTOOD AS CONSENT FOR ANY DATA PROVIDED TOBE USED AS DESCRIBED ABOVE

Further assistance or information about the research and its outcomes the research can be obtained from Achmad Room Fitrianto

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No. Questionnaire :		**Date :**			
Villages No :		**Sub District No :**			

PLEASE TICK ONE BOX

a. **Basic demographic data**

The following section will provide a broad profile of the survey participants.

1 What is your gender?

○ a. Male ○ b. Female

2 What is your age?

○ a.18-25 ○ c. 46-65

○ b.26-45 ○ d. 66+

3 Education background/ Highest level education completed

○ a. Primary School ○ b. Senior High School

○ c. Junior High School ○ d. University Graduate

○ e. Others, Please Specify……

……

4 How long have you been in shrimp industry?

○ a. Less than a year ○ c. 5-10

○ b. 1 -5 years ○ d. >10 years

Household data

5 How many people permanently reside in your house?

○ a.2-4 people ○ c.7-9 People

○ b.5-6 people ○ d. More than 10 people

Please provide the following data of each household member

No.	Name (initial)	Relationship to respondent	Gender		Age	Highest level of Education completed	Current Occupation
1.			M	F			
2.			M	F			
3.			M	F			
4.			M	F			
5.			M	F			
6.			M	F			
7.			M	F			

6. Does any of your children or your household member are working in the same company or same sector with you?

   ○ a. Yes, same company and same sector
   ○ b. Yes, but different company
   ○ c. No

7. What is your approximate total income from you shrimp enterprises?

   ○ a. Rp 100,000-Rp 500,0000
   ○ b. Rp 500,001-Rp 1000,000
   ○ c. Rp 1,000,001-Rp 1,500,000
   ○ d. Rp 1,500,001-Rp 2,000,000
   ○ e. Rp2,000,001-Rp 2,500,000
   ○ f. More than Rp 2,500,000

8. How do you pay your employees?
   Noted: could have more than one answer

   ○ A. Weekly
   ○ B. Monthly
   ○ C. Commissions, how many precent?
   ○ D. Profit sharing
   ○ **V. Others, please specify …….**

9. How much is your approximate household spending per month?

   ○ a. Rp 100,000-Rp 500,0000
   ○ b. Rp 500,001-Rp 1000,000
   ○ c. Rp 1,000,001-Rp 1,500,000
   ○ d. Rp 1,500,001-Rp 2,000,000
   ○ e. Rp2,000,001-Rp 2,500,000
   ○ f. More than Rp 2,500,000

b. The Business Profile

The following questions are concerned to portraying the aquaculture business organisation and its economic scale. In this section would questioned two issues, firstly the ponds/embankment premises condition, secondly the structure of the business, including the value of the business and the workers

10. Which of the following best describes your shrimp enterprise? Please mark all that apply What kind of ponds/embankment commodity that cultivated by you?

Noted: could have more than one answer

Type	The method	The products	Media
○ a. Ponds	○ a. Traditional ○ b. Semi intensive ○ c. Intensive ○ d. Organic ○ e. Other, Please specify…….. …… ……	○ 1.Shrimps ○ 2. Milkfish ○ 3. Shrimp and Milkfish ○ 4. Shrimp, Milkfish, and others ○ 5. Processing ○ 99. Others please specify…… ……	○ a. Brackish water ○ b. Brackish water (combined with nearest river) ○ c. Freshwater ○ d. Fresh water (originated from nearest river) ○ e. Saltwater ○ f. Others, Please specify…… ……

Type	The method	The products	Media
○ b. Embankments	○ a. Traditional ○ b. Semi intensive ○ c. Intensive ○ d. Organic ○ e. Other, Please specify…….. …… ……	○ 1.Shrimps ○ 2. Milkfish ○ 3. Shrimp and Milkfish ○ 4. Shrimp, Milkfish, and others ○ 5. Processing ○ 99. Others please specify…… ……	○ a. Brackish water ○ b. Brackish water (combined with nearest river) ○ c. Freshwater ○ d. Fresh water (originated from nearest river) ○ e. Saltwater ○ f. Others, Please specify…… ……

11. What date were the ponds /embankments first established?
    - ○ Day/Month /Year: ……/……/…….
    - ○ Not Sure
12. On this property, has the production method always been in fish or shrimp embankment?
    - ○ 1. Yes go to 13
    - ○ 3. No
13. If it was not fish or Shrimp embankment, what it was?
    Noted: could have more than one answer
    - ○ A. Padi's Filed
    - ○ B. Mangrove
    - ○ C. Swamp
    - ○ D. Savana
    - ○ V. Others, please specify……
14. Does your business have a legal form? If yes, what is the legal form and ownership status of the aquaculture business premises that you owned?

○ 1 Yes

Type of Company	Date established	Status of the premises
○ 1 Limited Company (Perseroan Terbatas/PT)	(……/……/……)	○ 1 Owned individually
○ 2 Commendatory (CV)	(……/……/……)	○ 2 Leased
○ 3 Trade Company	(……/……/……)	○ 3 Use for free
○ 99 Others, Please specify…… …… ……	(……/……/……)	○ 99 Others, Please specify…… …… …… ……

○ 3 No have Legal form

15. What are the total land areas that use for your business?
    - ○ a. Land: ……M2
    - ○ b. Building……M2
16. What is the total estimated value of your shrimp enterprises premise?
    Rp:……
17. Has your business been registered (registered for TDP- Tanda Daftar Perusahaan)
    - ○ 1.Yes it has, since ……/……/……
    - ○ 3.No…….go to 28
18. Do you have personal Tax file numbers (TFN)?
    - ○ 1.Yes , when it was issued ……/……/……
    - ○ 3.No…….go to 36
19. The TFN was made on behalf of?
    Note: Answer could be more than one
    - ○ A. Private
    - ○ B. Business
    - ○ V. Other, Please Specify……

20. Do you apply accounting records / financial records for this business?

○	1.	Earning Note or Spending note	○ 1	Yes	○ 3	No
○	2.	Daily Journal (Daily earnings and Daily Expenditures)	○ 1	Yes	○ 3	No
○	3.	Lost Profit Statement	○ 1	Yes	○ 3	No
○	4.	Balance Sheet income statement	○ 1	Yes	○ 3	No
○	95.	Others_____	○ 1	Yes	○ 3	No

21. Can you estimate how much initial capital was issued for starting the business?
Noted: initial start-up cost for the business exclude land building

○ 1 Yes

- ○ a. Less than Rp 2,500,0000
- ○ b. Rp 2500,001-Rp 5000,000
- ○ c. Rp 5,000,001-Rp 7,500,000
- ○ d. Rp 7,500,001-Rp 10,000,000
- ○ e. Rp10,000,001-Rp 12,500,000
- ○ f. More than Rp 12,500,000

○ 3 No

22. Has capital obtained in the business that you owned will used for any of the following purposes?
Note: Mark in order of importance with 1 being the most important

- ☐ A. To rent another pond
- ☐ B. To buy Shrimps feeds
- ☐ C. To pay the worker Salaries
- ☐ D. To buy Machine, Please specify……
- ☐ E. For hire consultant
- ☐ F. To develop new business, Please specify……..
- ☐ V. Others, please specify ……..

23. Which of the following source of operating capital for your business?
Noted: please mark all relevant answers

- ○ A. Bank,……(the name of bank)
- ○ B. Microfinance,……(the name of institution)
- ○ C. Cash and Converter (pegadaian)
- ○ D. Informal Moneylenders (rentenir)
- ○ E. Government Schema
- ○ F. Buying Using credit Schema from……
- ○ G Colleagues or extended family
- ○ V. Others, please specify ……..

24. Do you know what are the operational costs for running the business that you owned?

Noted: The operational cost including the worker's salary, transportation cost, row material cost and others

- ○ 1 Yes I know, Rp……
- ○ 3 No, I don't Involved

25. How frequently do you harvest your shrimp pond?
    - ○ A. One's a year
    - ○ B. Twice a Year
    - ○ C. Three times a year
    - ○ D. Four Times a Year
    - ○ V. More Than five times a year, Please Specify……..

26. Can you provide an estimate of the gross annual income of your enterprises?
    Note: If not sure just the estimation
    - ○ 1 Yes
        - ○ a. Less than Rp 25,000,0000
        - ○ b. Rp 25,000,001-Rp 50,000,000
        - ○ c. Rp 50,000,001-Rp 75,000,000
        - ○ d. Rp 75,000,001-Rp 100,000,000
        - ○ e. Rp100,000,001-Rp 125,000,000
        - ○ f. More than Rp 125,000,000
    - ○ 3 No

27. Has the gross annual income of the business change at any time in the past 6 years?
    - ○ 1. Yes
    - ○ 3. No…….go to …….

28 If Yes, have any of the following influenced that change?
    Note: could have more than one answer
    - ○ A. The occurrence the Mud Volcano
    - ○ B. National macro-economic conditions
    - ○ C. The price of raw material increasing
    - ○ D. A fall in the price of shrimp
    - ○ E. The government regulation, Please specify……
    - ○ V. Others, please specify ……..

29. Has the change in income been significant?
    - ○ A. Some change but not significant
    - ○ B. Plunge significantly, How many ……%
    - ○ C. Just in dry Season, How many ……%
    - ○ D. Just in Rain Season, How many ……%
    - ○ V. Others, please specify ……..

30. Have the operational costs changed in last six years?
    - ○ 1 Yes
    - ○ 3 Don't know go to……

31. Which of the following item were affected
    Note: Mark in order of importance with 1 being the most important
    - ☐ A. Wages and Salary
    - ☐ B. Raw material
    - ☐ C. Moorgate payment
    - ☐ D. Equipment
    - ☐ E. Maintenance
    - ☐ V. Others, please specify ……..

The worker's profile

This following questions aim to establish a profile of workers employed in the shrimp industry

32. How many workers are employed to operate your shrimp ponds and embankments?

……

33. Please indicate the number of workers who are usually employed at your shrimp ponds and embankments who usually reside at each of the following locations?

Please indicate how many for all categories that apply:

- ○ A. Communities closes to the pond location, ……..People.
- ○ B. Elsewhere in the same sub district (Kecamatan),……..People
- ○ C. Outside the sub district in which the ponds are located but still in the same district (kabupaten), ……..People
- ○ D. Outside the district (kabupaten) in which the ponds are located,……..People
- ○ V. Others, please specify ……..

34. Any of your family members employed in this business?

- ○ 1. Yes, ……people
- ○ 3. No……..got to

35. What is their relationship to you?

Note: mark all that are relevant

- ○ A. Children
- ○ B. Spouse
- ○ C. Spouse relative
- ○ D. Your relative
- ○ V. Others, please specify ……..

36. If Yes, which of the following apply to their situation?

Noted: could have more than one answer

- ○ A. They need a job
- ○ B. They are trust worthy
- ○ C. They are cheap
- ○ D. They have suitable skills
- ○ E. Have no other choices
- ○ V. Others, please specify ……..

The following questions concern the scope of marketing chains utilized by your shrimp enterprises. The aims to understand the significance of the aquaculture toward other sectors

37. Are you involved in marketing the products for the enterprises?
○ 1 Yes ○ 3 No, I don't involve, I have marketing staff ….go to 41

38. Which part of selling/marketing is your responsibility?
- ○ A Selling locally
- ○ B Helping in export preparation
- ○ V Others_____

39. Which markets does the shrimp enterprise that you owned usually services?
Note: Mark in order of importance with 1 being the most important

☐	1.	Local Villages
☐	2.	Innercity (Sidoarjo)
☐	3.	Other cities in East Java Province
☐	4.	Indonesian markets out side East Java Province
☐	5.	Overseas
☐	95.	Others_____

40. What are the payment methods that apply in your business?
Note: Mark in order of importance with 1 being the most important

☐	A.	Direct Payment
☐	B.	Credit
☐	V.	Others,……..

41. The Payment Instrument
Note: Mark in order of importance with 1 being the most important

☐	A.	Cash
☐	B.	Debit Card
☐	C.	Credit Card
☐	D.	Cheque
☐	E.	Bank Transfer
☐	V.	Others, please specify ……..

42. Please indicate what percentage of your total production is marketed in the traditional market
Note: Mark one circle only

- ○ A. 1-5%
- ○ B. 6-15%
- ○ C. 16-20%
- ○ D. 21-25%
- ○ E. More than 25%

43. Please indicate what percentage of total production from the enterprise that you owned is marketed in the export market.
Note: Mark one circle only

- ○ A. 1-10%
- ○ B. 11-20%
- ○ C. 21-30%
- ○ D. 31-40%
- ○ E. 41-50%
- ○ F. More than 50%

44. Which of the following products does the enterprise you owned send to the buyer?

Note: Mark in order of importance, with 1. being of greatest importance

☐	A.	Life Shrimps
☐	B.	HOSO (Head On Shell On)
☐	C.	HLSO (Head Less Shell On)
☐	D.	PD (Peel Devine)
☐	V.	Others, Please Specify……..

45. How do you send your harvested shrimp to the market?

- ○ A. Picked up directly by the buyer
- ○ B. You send to the depot with your own vehicle
- ○ C. You use a courier to deliver
- ○ D. All dispersal of the harvest is coordinated by a farmer association
- ○ V. Others, Please Specify……..

46. How important are each of this markets to your enterprises

			Very Important ⇒⇒Less Important				
			1	2	3	4	5
☐	A.	Export	○	○	○	○	○
	B.	Restaurants	○	○	○	○	○
	C.	Shrimp Crackers (Krupuk Udang)	○	○	○	○	○
	D.	Shrimp Paste (Petis udang)	○	○	○	○	○
☐	E.	Shrimp Nibles (makanan kecil)	○	○	○	○	○
	F.	Export manufacturing shrimp products	○	○	○	○	○
	G	Traditional warket	○	○	○	○	○
☐	V.	Others, Please Specify……..	○	○	○	○	○

c. Significant changes in the operation over time

This section aims to obtain information about the shrimp production process before and after the commencement of the Porong Mud Volcano.

47. Where does the enterprise that you owned obtain the following raw fish stock and supplies ?

Shrimp fries			Shrimp feed			Ponds/ Embankment equipment		
○	A.	Capture directly from The sea	○	A.	Scheduled by the association	○	A.	Assembling it self
○	B.	From agent recommended by the Agricultural Assistance Official (Petugas Penyuluh Pertanian)	○	B.	Scheduled by the Agricultural Assistance official (Petugas Penyuluh Pertanian)	○	B.	Assisted by the Agricultural Assistance Official (Petugas Penyuluh Pertanian)
○	C.	Supplied by the depot	○	C.	Direct order from the store based on your need	○	C.	Supplied by the depot
○	D.	Supplied by the buyers	○	D.	Ordered from Association according to the need (on demand)	○	D.	Supplied from buyer
○	E.	Purchased from hatchery	○	E.	Supplied by the buyers	○	E.	Purchase from the store
○	V.	Others, Please specify…… ……	○	V.	Others, please specify …… ……..	○	V.	Others, Please Specify…… ……

48. Delivery model that apply in sending the following items?

Shrimp fries	Shrimp feed	Ponds/ Embankment equipment
○ A. Sent by Seller	○ A. Sent by Seller	○ A. Sent by seller
○ B. Pick up on store	○ B. Pick up on store	○ B. Pick up on store
○ C. Using courrier agency	○ C. Using courrier agency	○ C. Using courrier agency
○ D. Coordinated by the association	○ D. Coordinated by the association	○ D. Coordinated by the association
○ V. Others, Please Specify…… .	○ V. Others, Please Specify……..	○ V. Others, Please Specify……

49. In the past 6 years, has there been any change in obtaining raw materials?
    - ○ A. Yes, Please comment what the difference……
      ……
    - ○ B. No……go to 51

50. Which of the following factors have contribute to the change?
    Note: could have more than one answer
    - ○ A. The occurring of mud volcano
    - ○ B. The national macro economy conditions
    - ○ C. The national price of the shrimp feed
    - ○ D. The price of Shrimp fall down
    - ○ E. The government regulation, Please specify……
    - ○ V. Others, please specify ……..

51 When did the change occur?
    - ○ A. Before 29 May 2006
    - ○ B. After 29 May 2006
    - ○ V. Others, Please specify……..

52 Is has there been change in production level (suddent drop in production / death)
    - ○ A. Sudden drop
    - ○ B. sudden death
    - ○ c sudden stock loss
    - ○ V. Others, Please specify……..

53 In the past 6 years, has the shrimp enterprise that you owned change its cultivation method in any way that you are aware of?
    - ○ 1. Yes
    - ○ 3. No…….go to 76

54 Which any of the following significantly determine the production level

			Very Important ⇒⇒Less Important				
			1	2	3	4	5
	A.	The Occurring of Mud Volcano	○	○	○	○	○
	B.	The National Macro economy conditions	○	○	○	○	○
	C.	The National price of the shrimp feed	○	○	○	○	○
	D.	The price of Shrimp fall down	○	○	○	○	○
	E.	The government regulation, Please specify…….	○	○	○	○	○
	V.	Others, please specify ……..	○	○	○	○	○

55 Do you practicing any special technique in cultivate shrimp especially in facing the water degradation quality caused by the occurring Mud Volcano in Porong?

○ 1 Yes please specify.....

○ 3 No

56 Do any local wisdoms or traditions inspire your cultivation techniques

○ 1 Yes please specify.....
.....

○ 3 No

57 Is there currently any government support to increase the harvest quality?

○ 1 Yes

○ 3 No

58 Which of the following government support that most needed in increasing the harvest quality?
Note: Mark in order of importance with 1 being the most important

	A.	Technical assistances
	B.	Financial assistences
	C.	Facilitate the post harvested process/ marketing asistance
	D.	Introducing role model
	V.	Others, please specify.....

59 Would any of the following be helpful

		Very Important ⇒⇒Less Important				
		1	2	3	4	5
A.	University research centre	○	○	○	○	○
B.	Commercial research centre	○	○	○	○	○
C.	Exporter company research centre	○	○	○	○	○
D.	Community develop indepent research	○	○	○	○	○
V.	Other, please specify…….	○	○	○	○	○

60 If you had adequate support, would you wish to change you CULTIVATION method that you applying?

- ○ 1. Yes
- ○ 3. No……. if no, what is the consequences……go to 76

61 If Yes, Would you tell the reason why do you changing?
Noted: could have more than one answer

- ○ A. Increase the productivity, up to……..%
- ○ B. Reducing the Risk of Harvest failure
- ○ C. Following the peers colleagues
- ○ D. In obtain the incentives offered
- ○ V. Others, please specify ……..

62 What kind of method do you use for water stock control?

- ○ A. Planting mangroves surrounding the ponds
- ○ B. Make water filter
- ○ C. Do nothing
- ○ D. Using pollutant- resistance seedlings
- ○ E. Others, please specify……

63 Does any assistance from outside parties in pollution prevention efforts
Note: if yes, could have more than one answers

- ○ 1 Yes
  - ○ A Governent Agencies
  - ○ B Company (CSR)
  - ○ C NGO
  - ○ D Shrimp exporter company
  - ○ E others, Please specify……
- ○ 3 No , go to

64 Which of the following outside parties support that most needed in pollution prevention efforts and increasing the harvest quality?
Note: Mark in order of importance with 1 being the most important

- [ ] A. Technical assistances
- [ ] B. Financial assistances
- [ ] C. Facilitate the post harvested process/ marketing assistance
- [ ] D. Introducing role model
- [ ] V. Others, please specify……

65 For How long you receipt the assistances?

- ○ A. Less than 1 month
- ○ B. 1-3 months
- ○ C. 4-6 months
- ○ D. one year
- ○ E. More than one years

66 What kind of initiatives have you establish yourself?

- ○ A. Conduct my own experiment
- ○ B. Conduct experiment with the farmer association
- ○ C. Seeking advice from other farmers or other farmer association who are located outside Sidoarjo
- ○ D. Seeking advice from other farmers or other farmer association who are located outside East Java
- ○ E. Other, please specify.....

d. The changes were related to the Porong mud volcano

This section is aimed to portrayed the shrimp farmer perspective toward the Porong mud volcano

No	Statement	No	Answer options				
			SA	A	NAD	D	SD
1	Since the disaster occurs do you have increased communication with the Village/ Sub District/district/provincial officials related to the problem faced?						
2	Do you consider that the Porong mud volcano has socially effect on your social life?	1	○	○	○	○	○
3	Has your relationship among the other shrimp farmers changed since the occurring of the Porong mud volcano?	2	○	○	○	○	○
4	As the owner of a shrimp enterprise has your need for communication with the local community change since the occurring of the Porong mud volcano?	3	○	○	○	○	○
5	Is the communication with the farmer association effective?	4	○	○	○	○	○
6	In order to adapt to the impact of the Porong mud volcano, have you need to apply new technique in shrimp farming ?	5	○	○	○	○	○
7	Has the enterprise that you owned required government?	6	○	○	○	○	○
8	Do banks/ financial institution are needed in solving the shrimp farmer problems	7	○	○	○	○	○
9	Does community support are needed in solving the shrimp farmer problems	8	○	○	○	○	○
10	Does shrimp exporter company supports are needed in solving the shrimp farmer problems?	9	○	○	○	○	○
11	Do you feel that you have fared better than other victims?	10	○	○	○	○	○
12	Have you had a need to change your business core?	11	○	○	○	○	○
13	Do you think the government (central/local) should provide assistance to you?	12	○	○	○	○	○
14	Do you think PT Lapindo should provide assistance to you?	13	○	○	○	○	○